State of Connecticut

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Fifty-First Report

OF THE

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

NEW HAVEN, CONN.

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FOR THE YEAR

1927

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CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

as of

October 31, 1927

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TABLE OF CONTENTS

	PAGE
Officers and Staff of the Station	iii
Table of Contents	iv
Report of the Board of Control	v
Report of the Treasurer	vi
Report of Insect Pest Appropriation	viii
Report of Expenses of Mosquito Control	x
Report of Tobacco Research Appropriation	xi
Report on Fertilizers, Bulletin 290	1
Report of the Director, Bulletin 291	91
Some Insect Pests of Nursery Stock in Connecticut, Bulletin 292	119
The Quality of Vegetable Seed bought by Market Gardeners in Connecticut, Bulletin 293	179
Report of the State and Station Entomologist, Bulletin 294	193
Report on Food and Drug Products, Bulletin 295	309
Index	357
Prolonging the Life of Tobacco Shade Tent Poles, Tobacco Station Bulletin 9	T1
Report of the Tobacco Station at Windsor, Tobacco Station Bulletin 10	T17
Bulletin of Immediate Information No. 61	1

Report of the Board of Control

OF

THE CONNECTICUT

AGRICUTURAL EXPERIMENT STATION

To His Excellency, John H. Trumbull, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith submits its fifty-first report for the year ending October, 31, 1927. The several financial statements included are for the fiscal year ended June 30, 1927.

Bulletin No. 291, included herewith, is the Report of the Director, and is a summary of progress made during the year, of resignations and appointments, additions to equipment and other pertinent matters. There are also included the Reports on Fertilizers, on Insect Pests, Food and Drug Products and the experiments on Tobacco at Windsor. Because of a change in the statute no report was issued on Commercial Feeding Stuffs.

The calls upon the Station for services of various kinds have continued to increase and the resources of both staff and plant have been taxed to the utmost. The invasion of this state by the Japanese Beetle, Oriental Peach Moth and the European Corn Borer especially, have called for extended efforts.

There have been no important changes in the personnel to report, other than those indicated in the Report of the Director.

All of which is respectfully submitted.

George A. Hopson,
Secretary.

Report of the Treasurer

July 1, 1926—June 30, 1927

W. L. SLATE, in account with THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION for the fiscal year ended June 30, 1927.

RECEIPTS.

Balance on hand, July 1, 1926:			
State General Appropriation			$4,932.13
State Comptroller (General or Current Expense)		$53,000.00	
" " (General—Additions)		1,206.40	
" " (Food and Drug)		7,500.00	
United States Appropriation (Hatch)		7,500.00	
" " " (Adams)		7,500.00	
" " " (Purnell)		14,000.00	
" " Reimbursement (Clark-McNary)		681.11	
Fertilizer Analysis Fees		12,000.00	
Feed Analysis Fees		6,000.00	
Lockwood Trust Fund		12,500.00	
			121,887.51
			$126,819.64
Miscellaneous Receipts:			
Balance on hand, July 1, 1926:		$657.40	
Sales of gasoline	$518.59		
Sales of automobile oil	29.57		
Mileage for use of automobiles	184.43		
Sale of stamped envelopes	5.10		
Sale of twine	.23		
Sale of waste paper	3.42		
Interest on bank deposits	69.86	811.20	
		$1,468.60	
LESS MISCELLANEOUS RECEIPTS DEPOSITED WITH STATE TREASURER		1,267.14	
			201.46
			$127,021.10

DISBURSEMENTS.

Salaries	$70,154.17
Labor	17,064.89
Stationery	1,301.07
Scientific Supplies (chemicals)	864.82
" " (other laboratory)	1,194.69
" " (photographic)	133.45
Feeding Stuffs	573.35
Insecticides, Fungicides, etc.	441.29
Lumber and Small Hardware	16.78
Miscellaneous Supplies	2,045.84
Automobile Oil	152.81

Food Samples	9.15	
Fertilizers	603.90	
Telegraph and Telephone	333.96	
Postage	455.37	
Travel (outlying investigations)	3,334.54	
" (meetings etc.)	1,209.14	
" (gasoline for automobiles)	1,375.90	
Freight, Express and Parcels Post	131.79	
Publications (bulletins etc.)	201.55	
" (miscellaneous)	79.50	
Coal	2,876.48	
Gas and Electricity	2,042.35	
Water	269.55	
Furniture and Fixtures (new)	1,546.27	
" " " (repairs)	204.70	
Library (books and periodicals)	1,256.73	
" (binding)	222.65	
Scientific Equipment (new)	1,834.13	
" " (repairs)	75.45	
Automobiles (new)	2,498.25	
" (repairs)	796.26	
Tools, Machinery and Appliances (new)	2,123.02	
" " " " (repairs)	151.86	
New Buildings and Structures	3,327.80	
Buildings (repairs and alterations)	3,339.49	
Grounds	24.75	
Insurance (fire, burglary and automobile)	1,352.41	
Taxes	4.20	
Miscellaneous Contingent Expenses	201.00	
Total Disbursements		$125,825.31
Balance on hand, June 30, 1927:		
State General Appropriation (in hands of State Comptroller)	$994.33	
Miscellaneous Receipts (in hands of Station Treasurer)	201.46	
		1,195.79
		$127,021.10

REPORT OF

W. L. SLATE, Treasurer

IN ACCOUNT WITH

Insect Pest Appropriation

July 1, 1926—July 1, 1927

RECEIPTS.

Insect Pest Appropriation		$17,500.00	
" " " (additions):			
Deficiency Appropr.	$13,500.00		
Miscellaneous Receipts	10.50	13,510.50	
		31,010.50	
Charged to allotment for second year of fiscal period, July 1, 1926		$4,567.93	
Net Receipts			$26,442.57
Miscellaneous Receipts:			
Balance July 1, 1926	$6.54		
Mileage for use of automobiles	3.96		
	10.50		
Less Miscellaneous Receipts Deposited with State Treasurer	10.50		
			$26,442.57

DISBURSEMENTS.

Salaries	15,570.31
Labor	2,967.96
Stationery and Office Supplies	101.62
Scientific Supplies (chemicals)	34.79
" " (other laboratory supplies)	32.21
" " (photographic)	43.58
Feeding stuffs	.55
Insecticides, etc.	2,586.60
Lumber and Small Hardware	9.48
Fuel Oil	459.53
Miscellaneous Supplies	175.86
Automobile Oil	38.38
Telegraph and Telephone	69.36
Postage	96.95
Travel (outlying investigations)	715.72
" (meetings, conferences etc.)	259.95
" (gasoline for automobiles)	427.25
Freight, Express and Parcels Post	149.00
Publications (zinc cut)	2.50
Coal	5.10

Electricity	4.00	
Water	34.60	
Furniture and Fixtures (new)	112.85	
" " " (repairs)	3.47	
Library (books and periodicals)	45.21	
Scientific Equipment (new)	143.06	
" " (repairs)	3.50	
Tools, Machinery and Appliances (new)	960.98	
" " " " (repairs)	41.65	
Automobiles (repairs)	475.86	
New Buildings and Structures	9.91	
Buildings (repairs and alterations)	16.04	
Rent of Land and Buildings	416.63	
Insurance (automobile)	225.41	
Miscellaneous Contingent Expenses	202.70	
Total Disbursements		$26,442.57

REPORT OF

W. L. SLATE, Director

IN ACCOUNT WITH

Mosquito Elimination Appropriation

For the Year Ended June 30, 1927

RECEIPTS.

State Appropriation	$7,500.00	
Additions (Madison $200, Branford $200 Westport $5,408.80, Westbrook $2,000)	7,808.80	
Deficiency Appropriation	3,000.00	
		18,308.80
Charged to allotment for second year of fiscal period		1,249.17
Total		$17,059.63

EXPENDITURES.

R. C. Botsford (salary)	$2,400.00	
Labor	10,649.78	
Stationery and Office Supplies	28.60	
Hardware supplies	4.73	
Photographic Supplies	4.08	
Miscellaneous Supplies	40.30	
Automobile Oil	7.69	
Oil for Mosquito Spraying	10.40	
Telephone and Telegraph	11.28	
Postage (excluding parcels post)	27.42	
Travel (meetings and conference and investigations)	37.86	
" (gasoline)	192.23	
Tools, Machinery and Appliances (new)	23.30	
" " " " (repairs)	19.30	
Automobile repairs	249.35	
Building New Culverts and Tide Gates	1,829.26	
Repairs to Culverts and Tide Gates	446.71	
Insurance (automobile)	64.66	
Contingent	14.50	
	16,061.45	
Transferred to New Mosquito Elimination Fund	346.62	
		$16,408.07
Balance on hand June 30, 1927		651.56

Tobacco Research Appropriation

July 1, 1926—June 30, 1927

Receipts.

Appropriation	$10,000.00	
Conn. Valley Tobacco Association	3,035.76	
Sales of Tobacco	2,749.37	
Misc. (rebate on insurance)	7.81	
Balance on hand June 30, 1926	1,620.54	
		$17,413.48

Expenditures.

Salaries	7,399.96	
Labor	5,183.71	
Stationery and Office Supplies	102.97	
Chemical and Laboratory Supplies	61.96	
Photographic Supplies	16.98	
Insecticides and Fungicides	11.00	
Lumber and Small Hardware	54.34	
Miscellaneous Supplies	440.12	
Automobile Oil	2.75	
Fertilizer	393.72	
Telephone and Telegraph	78.63	
Postage	40.00	
Travel (outlying investigations)	323.65	
" (Meetings)	109.94	
" (gasoline for automobiles)	42.47	
Freight, express and cartage	60.52	
Coal	387.50	
Electricity	330.09	
Furniture and Fixtures (new)	44.02	
" " " (repairs)	13.65	
Books and Periodicals	35.75	
" " " (binding)	17.50	
Scientific Apparatus (new)	516.57	
" " (repairs)	4.73	
Tools, Machinery and Appliances (new)	228.70	
" " " " (repairs)	6.85	
Automobiles (repairs)	139.60	
Buildings (repairs and alterations)	447.61	
Rent of land	75.00	
Insurance	840.19	
Contingent	3.00	
		$17,413.48

BULLETIN 290 OCTOBER, 1927

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Report on Inspection of Commercial Fertilizers for 1927

E. M. BAILEY, *Chemist in Charge of the Analytical Laboratory.*

CONTENTS.

	Page
The Fertilizer Law	3
Registrations	7
Inspection of 1927	17
Raw Materials Containing Nitrogen	18
Raw Materials Containing Phosphoric Acid	35
Raw Materials Containing Potash	40
Raw Materials Containing Nitrogen and Potash	47
Raw Materials Containing Nitrogen and Phosphoric Acid	48
Mixed Fertilizers:	
Containing Nitrogen and Phosphoric Acid	57
Containing Phosphoric Acid and Potash	57
Containing Nitrogen, Phosphoric Acid and Potash	57
Special Mixtures and Home Mixtures	78
Miscellaneous Fertilizers, Amendments, etc.:	
Sheep Manure, etc.	78
Lime, etc.	78
Other miscellaneous	86
Index	i

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

OFFICERS AND STAFF

BOARD OF CONTROL

His Excellency, John H. Trumbull, *ex-officio, President*

Charles R. Treat, *Vice-President* .... Orange
George A. Hopson, *Secretary* .... Mt. Carmel
Wm. L. Slate, *Director and Treasurer* .... New Haven
Joseph W. Alsop .... Avon
Elijah Rogers .... Southington
Edward C. Schneider .... Middletown
Francis F. Lincoln .... Cheshire

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N. T. Nelson, Ph.D., *Assistant Physiologist.*
T. R. Swanback, B.S., *Scientific Assistant.*

Report on Inspection
of
Commercial Fertilizers,
1927

E. M. Bailey,
Chemist in Charge, Analytical Laboratory.

THE FERTILIZER LAW.

The provisions of the Connecticut fertilizer law have been discussed in previous reports but for more ready reference its essential features may be noted here.

Significance of the Term "Commercial Fertilizers"

Explaining what is meant by the term "commercial fertilizers" the law says:

"The term 'commercial fertilizers' shall be construed to mean any and every substance imported, manufactured, prepared or sold for fertilizing or manuring or soil amendment purposes, except barnyard manure and stable manure which have not been artificially treated or manipulated, marl and lime. Cottonseed meal, rapeseed meal, castor pomace and all other vegetable products used as fertilizers, including the ashes of cotton hulls and wood ashes, shall be included as fertilizers within the meaning of this act and separate analysis fees shall be paid on each different grade which is sold or offered for sale in the state. The person responsible for paying the fees above prescribed may deduct from the total tonnage sold such sales of cottonseed meal or other vegetable products as are made to anyone who gives a written certificate on a form supplied by the Connecticut Agricultural Experiment Station stating that the material bought by him was to be used exclusively for feed and not for fertilizer."

Concerning Cottonseed Meal.

Cottonseed meal is a fertilizer within the meaning of the Statute but it is provided that when this product is sold for feeding purposes only, it shall be exempt from the tonnage tax. When sold as a feed, cottonseed meal is subject to registration under the terms of the feed law. By regulation, however, if it is sold exclusively as a fertilizer, or exclusively as a feed it may be registered but once, and under that law which applies.

The status of cottonseed meal under the fertilizer law has been clearly stated in bulletin[1] from this Station from which the following may be quoted:

Registration and analysis fees. "Each brand of cottonseed meal must be registered on forms provided by this Station and an analysis fee of ten dollars paid on it before it is sold, offered or exposed for sale, and on the first day of January annually thereafter."

[1] Bull. of Information No. 9, 1919.

"A distinctive name constitutes a distinct brand. If shipments have different guaranties of composition they are held to be different brands."

Branding or tagging. "Since nitrogen is the only fertilizer ingredient considered in the trade in cottonseed meal no guaranty of phosphoric acid or potash is required. If either is guaranteed by the manufacturer, however, an additional fee of ten dollars must be paid on each element. The statement of composition now legal for feeds may be used hereafter if the percentage of nitrogen is stated.

"Note that the law regarding feeding stuffs forbids the use of metal in attaching tags and requires that each package shall be branded or tagged with the statement required by law."

Duties of shippers. "It is assumed from correspondence with shippers outside the state that they will register the brands which they sell in Connecticut, will pay analysis fees as has been done in the past by manufacturers of commercial fertilizers, and will semi-annually thereafter pay the tonnage fees.

"They will report to this Station their total sales and if they wish, may report what part has been sold for feed exclusively. From the reports of dealers within the state it will be possible to determine quite closely the amounts of each brand actually used as feed.

"In the case the jobber outside the state neglects or refuses to register a brand, the dealer who sells it within the state is responsible under the law."

Duties of dealers. "Dealers are required to file with the director of the Station on July first of each year and semi-annually thereafter a sworn statement of their total sales of each brand of cottonseed meal and the amount of each sold exclusively for feed, during the preceding six months."

Requirements to be Complied with by Sellers of Commercial Fertilizers.

The seller is responsible for the proper labeling of each package, for the registration at the Station of every brand sold by him and for the payment of the analysis fee, before offering for sale, and annually thereafter on January 1st.

The law specifies the information which shall be given on the label as follows:

1. *Weight of each package in pounds.*
2. *Brand name or trade mark.*
3. *Analysis:*
   - (a) *Available phosphoric acid, per cent.*
   - (b) *Total phosphoric acid, per cent.*
   - (c) *Nitrogen, per cent.*
   - (d) *Equivalent ammonia, per cent.*
   - (e) *Potash soluble in water, per cent.*
4. *Name and address of the manufacturer or of the person who is responsible for the statement of the guaranty.*

In the case of bone meal, tankage or other organic products, and in basic slag and mineral phosphates in which a large percentage of the phosphoric acid is not available by laboratory methods, the

phosphoric acid shall be claimed as total phosphoric acid unless it is desired to claim available phosphoric acid instead, in which case the guaranty shall take the form set forth above.

The label may be a tag attached to the package or a statement printed thereon. Percentages shall be minimum percentages only.

The presence of leather in its various forms, wool waste, hair, or any inert nitrogenous material shall be declared on the label unless, by processing, the activity of these materials has been rendered satisfactory as determined by official methods.

When potash is derived from sulphate or carbonate of potash it may be so claimed.

No claim or guaranty for less than 0.82 per cent of nitrogen or for less than 1 per cent of phosphoric acid, or for less than 1 per cent of potash shall be regarded in the registration or analysis of any commercial fertilizer.

The seller must also, on the 1st of January and July, report the tonnage of fertilizer sold within the preceding six months and pay to the director of the Station a tonnage fee of 6 cents per ton. On request, copies of the law and blanks for registration and for tonnage reports will be supplied by the Station.

If, however, proper labeling, registration and payments have been provided for by the manufacturer of the brands or by another responsible person all sellers of such brands are released from the above mentioned requirements. The retailer, therefore, should assure himself that the requirements of the law have been met by the manufacturers of the brands which he handles, or himself be prepared to meet all these requirements.

Precautions to be Observed in Drawing Samples for Analysis.

The analysis of a fertilizer is of no value unless the sample analyzed represents as nearly as possible the stock from which the sample was drawn. The law prescribes the procedure to be followed by authorized agents of this Station when taking official samples for analysis as follows:

"When samples are taken from fertilizers in bags, a tube shall be used, and it shall be inserted at one end of the bag and shall pass substantially the entire length of the bag, so as to take a core of the material being sampled from substantially the entire length of the bag. Samples thus taken from individual bags shall be thoroughly mixed, and the official samples shall be taken from the mixture so drawn by the method known as 'quartering.' Samples of fertilizers taken as herein provided shall be taken from at least five per centum of the separate original unopened packages in the lot, for the mixture from which the official samples shall be taken. If less than one hundred bags are in the lot, at least five bags shall be sampled; if less than five bags, all shall be sampled. Broken packages shall not be sampled."

Gratuitous Analyses.

Under the fertilizer law the Station is charged only with the analysis of samples drawn by its own agents. It does, however, each year analyze a considerable number of samples drawn by individuals, representing stock purchased by them for their own use. The object of the purchaser is to satisfy himself as to whether he has obtained goods of the grade represented and, perhaps, to obtain evidence upon which to base a claim for shortage should the materials not meet their guaranties. The Station assumes no responsibility for the sampling in case of such unofficial samples and can only vouch for the accuracy of the results obtained on the materials as submitted. Since a representative sample is as essential as an accurate analysis in judging the quality of a shipment of fertilizer, it is evident that a satisfactory adjustment will seldom be effected on the basis of an unofficial sample. Notwithstanding certain objections which may be raised to the practice of analyzing samples submitted by individuals, the Station is disposed to continue such work so long as there is evidence that it constitutes a useful service.

REGISTRATIONS FOR 1927.

For 1927, 64 firms and individuals registered at this Station for sale in this State 414 brands of fertilizers. As required by Statute, the brands so registered are listed as follows:

American Agricultural Chemical Company, New Haven Sales Dept., New Haven, Conn.

A. A. C. 16% Acid Phosphate
AAC Tobacco Ash Element
AAC Tobacco Starter
Acme Fertilizer
Aroostook Potato Manure
Castor Pomace
Complete General Fertilizer
Cotton Seed Meal
Double A Tobacco Fertilizer
Double Manure Salts
Dry Ground Fish
Fine Ground Bone
Gladiator Fertilizer
Grass and Lawn Top Dressing
Hi-Grade Tobacco Manure
Monarch Fertilizer
Muriate of Potash
Nitrate of Soda
Old Hickory Fertilizer
Patapsco 5-8-7 Fertilizer
Pulverized Sheep and Goat Manure
Sulphate of Potash
Bowker's All Round Fertilizer
Bowker's Market Garden Fertilizer
Bowker's Potato and Vegetable Phosphate
Bowker's Stockbridge Early Crop Manure
Bowker's Stockbridge Hill and Drill Fertilizer
Bowker's Stockbridge Tobacco Manure
Bowker's Sure Crop Fertilizer
Bradley's Blood, Bone and Potash
Bradley's Complete Manure for Potatoes and Vegetables
Bradley's Complete Tobacco Manure
Bradley's Eclipse Fertilizer
Bradley's Northland Potato Grower
Bradley's Potato Fertilizer
Bradley's Potato Manure
Bradley's XL Superphosphate of Lime
National Aroostook Special Fertilizer
National Complete Tobacco Fertilizer
National Market Garden Fertilizer
National Pine Tree State Potato Fertilizer
National Premier Potato Manure
Sanderson's 5-8-7 Fertilizer
Sanderson's 5-10-5 Fertilizer
Sanderson's 3-12-3 Fertilizer
Sanderson's Atlantic Coast Mixture
Sanderson's Complete Tobacco Grower
Sanderson's Corn Superphosphate
Sanderson's Formula A
Sanderson's Formula B
Sanderson's Potato Manure

American Cyanamid Company, 535 Fifth Ave., New York City.

Ammo-Phos 20-20

Apothecaries Hall Company, Waterbury, Conn.

Acid Phosphate
Bone Meal 4-20
Bone Meal 3-22
Bone & Meat Tankage
Carbonate of Potash
Castor Pomace
Double Sulphate Potash and Magnesia
Dry Ground Fish
Liberty Corn and All Crops 2-8-2
Liberty Corn, Fruit and All Crops 2-12-4
Liberty Fish Bone and Potash 3-8-3
Liberty High Grade Market Gardeners 5-8-7
Liberty High Grade Tobacco Manure 7-4-7
Liberty Home Vegetable Garden Fertilizer
Liberty Lawn Fertilizer
Liberty Onion Special (Potash as Sulphate)* 4-8-7
Liberty Potato and General Crops 4-8-10
Liberty Potato and Market Gardeners Special 4-8-4
Liberty Potato and Vegetable 2-8-10
Liberty Sheep Manure
Liberty Tobacco Special 5-4-5
Liberty Top Dresser for Grass and Grain 10-3½-8
Muriate Potash
Nitrate Soda
Nitrate Soda and Potash
Precipitated Bone
Sulphate Potash
Tankage

Armour Fertilizer Works, 50 Broad St., New York City.

Armour's Big Crop Acid Phosphate 16%
Armour's Big Crop Bone Meal 3-48
Armour's Big Crop Fertilizer 8-6-6
Armour's Big Crop Fertilizer 5-8-7
Armour's Big Crop Fertilizer 4-6-10
Armour's Big Crop Fertilizer 4-8-7
Armour's Big Crop Fertilizer 4-8-4
Armour's Big Crop Fertilizer 4-16-4
Armour's Big Crop Fertilizer 3-8-4
Armour's Big Crop Fertilizer 2-12-4
Armour's Big Crop Super Phosphate 20%
Armour's Big Crop Tobacco Special 5-4-5
Armour's Castor Pomace 5½%
Armour's Corn Grower 2-8-2
Armour's Cotton Seed Meal 8%
Armour's Dried Ground Fish 10%
Armour's Ground Tankage 9%
Armour's Lawn and Garden Grower 6-8-6
Armour's Muriate of Potash 48%
Armour's Nitrate of Soda 18%
Armour's Sheep Manure 1½-1-2
Armour's Sulphate of Potash 48%

Ashcraft-Wilkinson Company, Atlanta, Ga.
Helmet Brand
Monarch Brand
Paramount Brand

Atlantic Packing Company, New Haven, Conn.
Atlantic Grain Fertilizer 2-10-2
Atlantic Special Vegetable 4-8-4
Atlantic Tobacco Grower 5-4-5
Atlantic Tobacco Manure 5-8-6
Atlantic 5-4-16

Baker Castor Oil Company, 120 Broadway, New York City.
Castor Pomace

E. J. Bantle, Glastonbury, Conn.
Bantle's Wrapper Brand

Barrett Company, 40 Rector St., New York City.
Arcadian Sulphate of Ammonia

The F. A. Bartlett Tree Expert Co., Stamford, Conn.
Bartlett's Green Tree Food

The Berkshire Chemical Company, Bridgeport, Conn.
Berkshire Acid Phosphate
Berkshire Castor Pomace
Berkshire Complete Fertilizer
Berkshire Complete Tobacco
Berkshire Dry Ground Fish
Berkshire Economical Grass Fertilizer
Berkshire Fine Ground Bone
Berkshire Grass Special
Berkshire Long Island Special
Berkshire Market Garden Fertilizer
Berkshire Potato and Vegetable Phosphate
Berkshire Sheep Manure
Berkshire Starter with 10% Potash
Berkshire Tobacco Special
Boardman's Complete Fertilizer
High Grade Sulphate Potash
Muriate Potash
Nitrate of Soda
Precipitated Bone Phosphate

Amos D. Bridge's Sons, Incorporated, Hazardville, Conn.
Corn, Onion and Potato and General Purpose
Special Tobacco Fertilizer

F. W. Brode Corporaton, Memphis, Tenn.
Owl Brand 41% Cotton Seed Meal

A. H. Case & Company, Incorporated, Buffalo, N. Y.
Case's Brand Pulverized Sheep Manure

The E. D. Chittenden Company, 1115 Main St., Bridgeport, Conn.

Chittenden's Acid Phosphate
Chittenden's Castor Pomace
Chittenden's Complete Grain
Chittenden's High Grade Potato 7% Potash
Chittenden's High Grade Tobacco
Chittenden's Nitrate of Soda
Chittenden's Potato Special 4% Potash
Chittenden's Special Top Dresser
Chittenden's Tobacco Special
Chittenden's Tobacco Starter
Chittenden's Vegetable and Onion Grower
Fine Ground Bone

Everett B. Clark Seed Company, Milford, Conn.

16% Acid Phosphate
Nitrate of Soda
Special Mixture for General Use
Special Mixture with 6% Potash
Super Phosphate
Tip Top Brand

The Conn. Fat Rendering & Fertilizer Corp., New Haven, Conn.

Tankage

Consolidated Rendering Company, 40 North Market St., Boston, Mass.

Acid Phosphate
Castor Pomace
Corenco Sheep Manure
Dry Ground Fish
Ground Bone
Muriate of Potash
Nitrate of Soda
Sulphate of Ammonia
Sulphate of Potash
Tankage 6-30
Tankage 9-20

C. A. Cowles, Plantsville, Conn.

C. A. Cowles 4-8-4 Fertilizer

C. & R. Sales Co., Worcester, Mass.

C. & R. Lawn Shrub

Davey Tree Expert Company, Inc., Kent, Ohio.

Davey Shredded Cattle Manure
Davey Tree Food

Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.

Eastern States Acid Phosphate
Eastern States Fine Bone Meal
Eastern States High Analysis Fertilizer 8-16-20
Eastern States High Analysis Fertilizer 10-16-14
Eastern States High Analysis Fertilizer 8-16-8
Eastern States High Analysis Fertilizer 4-16-4
Eastern States Muriate of Potash

Eastern States Nitrate of Soda
Eastern States No Filler 3-12-3
Eastern States No Filler Fertilizer 4-8-10
Eastern States No Filler 5-8-7
Eastern States No Filler Fertilizer 5-10-5
Eastern States No Filler Fertilizer 8-6-6
Eastern States Open Formula A Tobacco Fertilizer
Eastern States Sulphate of Ammonia
Eastern States Sulphate of Potash

Ed. Eggert, Hartford, Conn.
Cotton Seed Hull Ashes

Essex Fertilizer Company, 39 North Market St., Boston, Mass.
Essex A1 Superphosphate 2-10-2
Essex Complete Manure 5-8-7
Essex Fish Fertilizer, For All Crops 3-8-4
Essex Market Garden 4-8-4
Essex Tobacco Grower 5-4-5
Essex Top Dressing 7-6-5

Ford Motor Company, Detroit, Michigan.
Ford Ammonium Sulphate

Four Seasons Fertilizer Co., Inc., 135 West 29th St., New York City.
Four Seasons Fertilizer

L. T. Frisbie Co., New Haven, Conn.
Frisbie's Corn and Grain Fertilizer 2-10-2
Frisbie's Fine Bone Meal
Frisbie's 5-8-7
Frisbie's Market Garden 4-8-7
Frisbie's Special 3-8-4
Frisbie's Special Vegetable and Grower 4-8-4
Frisbie's Tobacco Grower 5-4-5
Frisbie's Tobacco Manure 5-8-6
Frisbie's Top Dresser 7-6-5
Frisbie's 3/50 Bone Meal

Grasselli Chemical Company, Cleveland, Ohio.
Grasselli Odorless Plant Food

Humphreys-Godwin Company, Memphis, Tenn.
Bull Brand Cottonseed Meal
Danish Brand Cottonseed Feed
Dixie Brand Cottonseed Meal

International Agricultural Corporation, 126 State St., Boston, Mass.
Acid Phosphate
Basic Slag
Bone Meal
Castor Pomace
Cottonseed Meal 43%
I. A. C. Connecticut Valley Special
I. A. C. Crop Grower
I. A. C. General Favorite
I. A. C. High Grade Manure

I. A. C. Ideal
I. A. C. New England Special
I. A. C. Nitrate of Soda
I. A. C. Tobacco Producer
Rainbow Brand Cottonseed Meal
Special 4-8-6
Sulphate of Potash
Tankage

John Joynt, Lucknow, Ontario, Canada.
Joynt Brand, Wood Ashes

Spencer Kellogg & Sons, Inc., Buffalo, N. Y.
Castor Pomace
Linseed Meal

Kuttroff, Pickhardt & Co., Inc., 1150 Broadway, New York City.
Calcium Nitrate B. A. S. F. (Nitrate of Lime)
Urea B. A. S. F. (Floranid)

Lowell Fertilizer Company, 40 North Market St., Boston, Mass.
Lowell Animal Brand A High Grade Manure 3-8-4
Lowell Bone Fertilizer 2-10-2
Lowell Corn and Vegetable 4-8-4
Lowell Market Garden Manure 5-8-7
Lowell Potato Phosphate 4-8-7
Lowell Top Dressing 7-6-5
Lowell Tobacco 5-4-5
Lowell 8-6-6
Lowell 5-10-5
Lowell 3-12-3

L. B. Lovitt & Company, Memphis, Tenn.
"Lovit Brand" 41%
"Lovit Brand" 43%

The Mapes Formula & Peruvian Guano Co., 270 Madison Ave., New York City.
The Mapes Connecticut Valley Special
The Mapes Corn Manure
The Mapes General Tobacco Manure
The Mapes General Truck Manure
The Mapes General Use Manure
The Mapes Onion Manure
The Mapes Potato Manure
The Mapes Special Trucker
The Mapes Tobacco Ash Constituents
The Mapes Tobacco Ash and Starter
The Mapes Tobacco Manure, Wrapper Brand
The Mapes Tobacco Starter Improved
The Mapes Top Dresser
Pure Fine Ground Bone
Nitrate of Soda
Sulphate of Potash

A. G. Markham & Company, Sprngfield, Mass.

4-8-4
5-8-7

Memphis Cottonseed Products Company, Memphis, Tenn.

Durham Forty-Three Cottonseed Meal

Natural Guano Company, Aurora, Illinois.

"Sheep's Head" Pulverized Sheep Manure

R. N. Neal & Company, Memphis, Tenn.

"Triangle" Brand 41%

New England Fertilizer Company, 40 A North Market St., Boston, Mass.

New England Complete Manure 4-6-10
New England Corn Phosphate 2-10-2
New England Market Garden Manure 5-8-7
New England Potato and Vegetable Manure 4-8-4
New England Superphosphate A High Grade Fertilizer For All Crops 3-8-4
New England Tobacco Manure 5-4-5
New England Top Dressing 7-6-5

Olds & Whipple, Inc., Hartford, Conn.

O & W Acid Phosphate
O & W Castor Pomace
O & W Complete Market Garden Fertilizer
O & W Complete Tobacco Fertilizer
O & W Dry Ground Fish
O & W Grain and General Crop Fertilizer
O & W Grass Fertilizer
O & W High Grade Starter and Potash Compound
O & W High Grade Tobacco Starter
O & W High Grade Vegetable and Potato Fertilizer
O & W Nitrate of Soda
O & W Precipitated Bone
O & W Pure Bone Meal
O & W Tobacco Fertilizer, Blue Label Brand
High Grade Carbonate of Potash, 96-98
High Grade Sulphate of Potash

Old Deerfield Fertilizer Co., Inc., South Deerfield, Mass.

Old Deerfield Castor Pomace
Old Deerfield 7-4-7
Old Deerfield 5-8-7

Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, Cal.

Grozit Brand (Pulverized Sheep Manure)

Parmenter & Polsey Fertilizer Company, 41 North Market St., Boston, Mass.

"P & P" "AA" Brand 5-8-7
"P & P" Maine Potato Fertilizer 4-6-10
"P & P" Plymouth Rock Brand For All Crops 3-8-4
Parmenter & Polsey Corn and Vegetable 4-8-4

Piedmont Mt. Airy Guano Co., Baltimore, Md.

Harvest Brand 16% Acid Phosphate
Harvest Brand 2-8-2
Harvest Brand 3-8-4
Harvest Brand 4-6-10
Harvest Brand 4-8-4
Harvest Brand 5-8-7
Muriate of Potash
Nitrate of Soda
Piedmont 16% Acid Phosphate
Piedmont 4-8-10 Fertilizer
Piedmont 5-8-7 Fertilizer
Piedmont 8-6-6 Fertilizer
Piedmont 4-6-10 Fertilizer
Piedmont Plow Brand
Piedmont Unexcelled Guano
Steam Bone

Frank S. Platt Co., 450 State St., New Haven, Conn.

Platco Special 5-8-7

Premier Poultry Manure Co., 431 So. Dearborn St., Chicago, Illinois.

Premier Brand Poultry Manure
Premier Brand Sheep Manure

The Pulverized Manure Co., 828 Exchange Ave., Chicago, Illinois.

Wizard Brand Cattle Manure
Wizard Brand Pulverized Sheep Manure

Rackliffe Brothers Company, Inc., New Britain, Conn.

4-8-4 Rackliffe Brand
5-8-7 Rackliffe Brand
Nitrate of Soda

Rocky Mountain Fertilizer Co., Helena, Mont.

Wonder Grower Pulverized Sheep Manure

The Rogers & Hubbard Company, Portland, Conn.

4-8-4
5-8-7
Acid Phosphate
Garden Fertilizer
Hubbard's "Bone Base" Fertilizer for Seeding Down
Hubbard's "Bone Base" Oats and Top Dressing
Hubbard's "Bone Base" Soluble Corn and General Crops Manure
Hubbard's "Bone Base" Soluble Potato Manure
Hubbard's "Bone Base" Soluble Tobacco Manure
Hubbard's Pure Raw Knuckle Bone Flour
Hubbard's Strictly Pure Fine Bone
Nitrate of Potash
Rogers & Hubbard's All Soils-All Crops Fertilizer
Rogers & Hubbard's Climax Tobacco Brand
Rogers & Hubbard's Corn and Grain Fertilizer
Rogers & Hubbard's High Potash Fertilizer
Rogers & Hubbard's Potato Fertilizer
Rogers & Hubbard's Tobacco Grower, Vegetable Formula

F. S. Royster Guano Company, 602 Citizens' Nat'l Bank Bldg., Baltimore, Md.

Cottonseed Meal
Nitrate of Soda
Royster's 16% Acid Phosphate
Royster's 5% Truck Guano
Royster's Gem Guano
Royster's Ground Dried Fish Scrap
Royster's Pure Raw Bone Meal
Royster's Quality Trucker
Royster's Rational Guano
Royster's Spearhead Guano
Royster's Top Dresser
Royster's Trucker's Delight
Royster's Valley Tobacco Guano
Sheep Manure
Sulphate of Ammonia
Sulphate of Potash

M. L. Shoemaker & Co., Inc., Venango St. & Delaware Ave., Philadelphia, Pa.

"Swift-Sure" Ammoniated Phos Quick Grower 5-8-7
"Swift-Sure" Four and Half Bone Meal
"Swift-Sure" Tobacco and General Use (Pot. fr. Sulphate) 3-10-3
"Swift-Sure" Tobacco Special
"Swift-Sure" Tobacco Starter 4-10-0

Springfield Rendering Co., Springfield, Mass.

Springfield Animal Brand 3-8-4
Springfield Market Garden Grower and Top Dresser 5-8-7
Springfield Special Potato, Onion and Vegetable 4-8-4
Springfield Tobacco Special 5-4-5
Springfield 4-8-7

Swift & Company Fertilizer Works, Baltimore, Md.

Vigoro

I. P. Thomas & Son Company, 1000 Drexel Bldg., Philadelphia, Pa.

16% Acid Phosphate
Economy Fertilizer 3-12-3
I. P. Thomas 5-8-7
Long Island Special 4-8-7
Muriate of Potash
Nitrate of Soda
Pure Ground Bone
Tankage
Thomas' Fish and Potash Fertilizer 5-8-5
Thomas' Tobacco Grower 5-4-5
Tip-Top Super-Phosphate 3-10-6
Truckers' High Grade Guano 4-8-4
Victor Potash Fertilizer 2-8-5
7% Guano

Triton Oil and Fertilizer Company, 101 Beekman St., New York City.

Acid Phosphate
Nitrate of Soda
Triton 4-8-4 Fertilizer
Triton 4-8-7 Fertilizer

United States Guano Co., Baltimore, Md.

Standard United States 3-9-2
Standard United States 4-8-10
Standard United States 5-8-5
Standard United States 16% Acid Phosphate
Standard United States Bone Meal
Standard United States Ever Green Fish Guano
Standard United States Mammoth Potato Grower
Standard United States Nitrate of Soda
Standard United States Royal Potato Grower

Virginia-Carolina Chemical Corporation, 120 Broadway, New York City.

V-C Aroostook Potato Grower
V-C Fairway Fertilizer
V-C XXXX Fish and Potash

Wilcox Fertilizer Company, Mystic, Conn.

Acid Phosphate
Ground Blood and Meat Tankage
Ground Steamed Bone
Nitrate of Soda, containing Potash
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox General Vegetable Phosphate
Wilcox High Grade Fish and Potash
Wilcox Potato Fertilizer
Wilcox Special 4-8-4 Fertilizer
Wilcox 7-6-5 Top Dresser

Worcester Rendering Co., Auburn, Mass.

Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain Fertilizer
Prosperity Brand Market Garden Fertilizer
Prosperity Brand Potato and Vegetable Fertilizer

S. D. Woodruff & Sons, Orange, Conn.

"Toro" Brand of Sheep Manure
Woodruff's Home Mixed Fertilizer

Wm. P. Young & Son, 22-24 High St., Pottstown, Pa.

Young's Formula A Complete Fertilizer

INSPECTION OF 1927.

During the past season the Station agent has visited 95 towns and villages in the State and has drawn 507 official samples of fertilizers, including all of the registered brands which could be found. These, together with samples submitted by purchasers, and others interested, are classified as follows:

CLASSIFICATION OF FERTILIZERS ANALYZED IN 1927.

	Number of Samples	Page
I. *Containing Nitrogen as the chief active ingredient.*		
Nitrate of Soda	31	18
Sulphate of Ammonia	8	18
Urea	1	21
Calcium Nitrate	2	21
Castor Pomace	74	22
Cottonseed Meal	174	27
Linseed Meal	8	27
II. *Containing Phosphoric Acid as the chief active ingredient:*		
Precipitated Bone Phosphate	8	35
Superphosphate (Acid Phosphate)	22	37
III. *Containing Potash as the chief ingredient:*		
Carbonate of Potash	11	40
Muriate of Potash	9	40
Sulphate of Potash	22	41
Sulphate of Potash-Magnesia	2	41
Cotton Hull Ashes	12	41
Wood Ashes	14	41
IV. *Containing Nitrogen and Potash:*		
Nitrate of Potash and Soda	3	47
Nitrate of Potash	2	47
V. *Containing Nitrogen and Phosphoric Acid:*		
Dry Ground Fish	34	48
Tankage	8	52
Ground Bone	37	52
VI. *Mixed Fertilizer:*		
Containing Nitrogen and Phosphoric Acid	5	57
Containing Phosphoric Acid and Potash	1	57
Containing Nitrogen, Phosphoric Acid and Potash	243	57
Special and Home Mixtures	39	78
VII. *Miscellaneous fertilizers, amendments, waste products, etc.:*		
Sheep Manure, etc.	17	78
Lime, etc.	21	78
Miscellaneous, including check meals and fertilizers	76	86
Total	884	

United States Guano Co., Baltimore, Md.

Standard United States 3-9-2
Standard United States 4-8-10
Standard United States 5-8-5
Standard United States 16% Acid Phosphate
Standard United States Bone Meal
Standard United States Ever Green Fish Guano
Standard United States Mammoth Potato Grower
Standard United States Nitrate of Soda
Standard United States Royal Potato Grower

Virginia-Carolina Chemical Corporation, 120 Broadway, New York City.

V-C Aroostook Potato Grower
V-C Fairway Fertilizer
V-C XXXX Fish and Potash

Wilcox Fertilizer Company, Mystic, Conn.

Acid Phosphate
Ground Blood and Meat Tankage
Ground Steamed Bone
Nitrate of Soda, containing Potash
Wilcox Corn Special
Wilcox Dry Ground Fish
Wilcox General Vegetable Phosphate
Wilcox High Grade Fish and Potash
Wilcox Potato Fertilizer
Wilcox Special 4-8-4 Fertilizer
Wilcox 7-6-5 Top Dresser

Worcester Rendering Co., Auburn, Mass.

Prosperity Brand Complete Dressing
Prosperity Brand Corn and Grain Fertilizer
Prosperity Brand Market Garden Fertilizer
Prosperity Brand Potato and Vegetable Fertilizer

S. D. Woodruff & Sons, Orange, Conn.

"Toro" Brand of Sheep Manure
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Muriate of Potash	9	40
Sulphate of Potash	22	41
Sulphate of Potash-Magnesia	2	41
Cotton Hull Ashes	12	41
Wood Ashes	14	41
IV. *Containing Nitrogen and Potash:*		
Nitrate of Potash and Soda	3	47
Nitrate of Potash	2	47
V. *Containing Nitrogen and Phosphoric Acid:*		
Dry Ground Fish	34	48
Tankage	8	52
Ground Bone	37	52
VI. *Mixed Fertilizer:*		
Containing Nitrogen and Phosphoric Acid	5	57
Containing Phosphoric Acid and Potash	1	57
Containing Nitrogen, Phosphoric Acid and Potash	243	57
Special and Home Mixtures	39	78
VII. *Miscellaneous fertilizers, amendments, waste products, etc.:*		
Sheep Manure, etc.	17	78
Lime, etc.	21	78
Miscellaneous, including check meals and fertilizers	76	86
Total	884	

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA.

Commercial grades of nitrate of soda contain from 91 to 97 per cent of sodium nitrate, equivalent to from 15 to 16 per cent of nitrogen or 18.2 to 19.5 per cent of ammonia. The salt may contain also small amounts (2 to 3 per cent), of potassium and magnesium chlorides, sodium sulphate and sodium iodide.

Thirty-one samples were analyzed and all met or exceeded guaranties so far as guaranties were given. Seventeen were sampled by the Station agent and the remainder were sampled by purchasers.

The average nitrogen content is 15.52 per cent. Prices quoted ranged from $63.00 to $80.00, the average being about $68.00. Nitrogen from this source has cost about 21.9 cents per pound.

Analyses are given in Table I.

SULPHATE OF AMMONIA.

Ammonium sulphate is chiefly obtained as a by-product in the manufacture of coke and illuminating gas. Commercial grades of this material contain about 20.5 per cent of nitrogen, which is equivalent to 25 per cent of ammonia. It also may contain from ½ to 2 per cent of moisture and a little free sulphuric acid (0.1 to 0.3 per cent).

Arcadian sulphate of ammonia is specially dried and screened to remove lumps and to insure good distribution when applied. It contains less than ½ of 1 per cent of moisture and is usually guaranteed to contain 20.75 per cent of nitrogen.

Eight samples were analyzed and all exceeded 20.5 per cent of nitrogen, the average being 20.67 per cent. Only one ton price was quoted, viz., $69.00, at which the cost of nitrogen is about 16.7 cents per pound.

Analyses are given in Table II.

TABLE I. ANALYSES OF NITRATE OF SODA.

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cen Nitroge Found.
6613	American Agricultural Chemical Co., New York........	Station agent. Stock of F. S. Bidwell Co., Windsor Locks........	15.26
6623	American Agricultural Chemical Co., New York........	J. C. Dufford, Glastonbury......	15.40
6291	Apothecaries Hall Co., Waterbury, Conn...............	Hatheway & Steane, Inc., Hartford........................	15.38
6338	Apothecaries Hall Co., Waterbury, Conn...............	Hatheway & Steane, Inc., Hartford........................	15.42
6371	Apothecaries Hall Co., Waterbury, Conn...............	Hatheway & Steane, Inc., Hartford........................	15.66
6377	Apothecaries Hall Co., Waterbury, Conn...............	Hatheway & Steane, Inc., Hartford........................	15.66
6611	Apothecaries Hall Co., Waterbury, Conn...............	Station agent. Stock of R. W. Hine, Cheshire..............	15.42
7144	Apothecaries Hall Co., Waterbury, Conn...............	A. N. Shepard & Son, Hartford...	15.56
6699	Armour Fertilizer Works, New York....................	Station agent. F. A. Bartlett Tree Expert Co., Stamford.....	15.68
6637	Berkshire Chemical Co., Bridgeport..............	Station agent at factory.........	15.50
7221	E. D. Chittenden Co., Bridgeport....................	Station agent. Stock of Fred Schlichting, Broad Brook......	15.42
6701	E. B. Clark Seed Co., Milford.	Station agent at factory.........	15.38
6633	Consolidated Rendering Co., Boston, Mass.............	Station agent. Stock of Frank Libner & Son, Norwalk........	15.62
6957	Consolidated Rendering Co., Boston, Mass.............	Daigle Bros., Marion............	15.32
6704	Eastern States Farmer's Exchange, Springfield, Mass...	Station agent. Stock of Stephen Hoyt's Sons, New Canaan.....	15.44
6731	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield..................	15.60
6732	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield..................	15.56
6733	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield..................	15.34
6734	W. R. Grace & Co., New York	American Sumatra Tobacco Co., Bloomfield..................	15.60
6878	International Agricultural Corp., Boston, Mass.......	Station agent. Stock of Willimantic Grain Co., Willimantic..	15.92
6657	Mapes Formula & Peruvian Guano Co., New York.....	Station agent. Stock of Mapes Branch, Hartford............	15.34
6676	Olds & Whipple Inc., Hartford	Station agent. Stock of Silberman & Kahn, Hartford........	15.22
7530	Olds & Whipple Inc., Hartford	John M. Herr, Burnside.........	15.64
7184	Piedmont Mt. Airy Guano Co., Baltimore, Md........	Station agent. Stock of Fred H. Rolf, Inc., Guilford...........	15.42

TABLE I. ANALYSES OF NITRATE OF SODA—*Concluded*

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
7177	Rackliffe Bros., Co., New Britain	Station agent at factory	15.64	15.00
6845	F. S. Royster Guano Co., Baltimore, Md.	Station agent. Stock of Geo. S. Phelps & Co., Thompsonville	15.38	15.00
6749	I. P. Thomas & Son Co., Philadelphia, Pa.	Station agent. Stock of F. C. Morse & Son, Guilford	15.54	15.00
6922	Triton Oil & Fertilizer Co., New York	Station agent. Stock of Red Wing Feed & Lumber Co., Colchester	15.38	14.80
7353	United States Guano Co., Baltimore, Md.	Station agent. Stock of E. O. Chapman, North Haven	16.70	15.00
6138	Wessel Duval Co.	Conn. Sumatra Tobacco Co., Buckland	15.32	....
6139	Wessel Duval Co.	Conn. Sumatra Tobacco Co., Buckland	15.54	....

TABLE II. ANALYSES OF SULPHATE OF AMMONIA

Station No.	Manufacturer or Jobber.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found.	Per cent Nitrogen. Guaranteed.
6642	The Barrett Company, New York	Station agent. Stock of Berkshire Chemical Co., Bridgeport	20.86	20.75
7140	The Barrett Company, New York	A. N. Shepard & Son, Hartford	20.54	20.75
6956	Consolidated Rendering Co., Boston	Daigle Bros., Marion	20.58	20.50
6635	Consolidated Rendering Co., Boston	Station agent. Stock of L. T. Frisbie Co., New Haven	20.54	20.50
7470	Consolidated Rendering Co., Boston	Station agent. Stock of G. S. Jennings, Southport	20.60	20.50
6702	Eastern States Farmers' Exchange, Springfield, Mass.	Station agent. Stock of Stephen Hoyt's Sons, New Canaan	20.52	20.55
7098	Ford Motor Co., Detroit, Mich.	Manufacturer's sample	21.00	20.80
7181	F. S. Royster Guano Co., Baltimore, Md.	Station agent. Stock of W. S. Brown, Trumbull	20.74	20.56

UREA.

Urea is one of the newer ammoniates and is made synthetically in Europe on a considerable scale. It is a white crystalline substance and the grade offered for fertilizer purposes contains about 45 per cent of nitrogen equivalent to 55 per cent of ammonia. In a pure state urea contains 46.65 per cent of nitrogen.

One sample, **6904,** was analyzed. It was taken by the Station agent from stock of Olds and Whipple, Hartford, the American agents being Kuttroff, Pickhardt and Co., Inc., New York. The salt was guaranteed to contain 46 per cent of nitrogen, equivalent to 55.9 per cent of ammonia, and was found to contain 46.08 per cent of nitrogen equivalent to 55.94 per cent ammonia.

Urea leaves no residue in the soil and it said to equal nitrate of soda in availability. Many tests are being made in this and other States to determine the value of this material for fertilizer purposes.

NITRATE OF LIME.

Nitrate of lime or calcium nitrate is produced by combining lime or limestone with nitric acid. It is produced in large quantities in Europe, where atmospheric nitrogen is utilized for the producton of nitric acid.

The salt absorbs moisture to such an extent that it is shipped in drums or in paper-lined bags. The grade offered for fertilizer purposes contains about 15.5 per cent of nitrogen equivalent to 18.8 per cent of ammonia. The lime (CaO), content is about 30 per cent.

Two samples were examined.

5836. Purchased by the Station for experimental purposes. It contained 15.52 per cent of nitrogen equivalent to 18.87 per cent of ammonia.

6903. Sampled from stock of Olds and Whipple, Hartford; jobbers, Kuttroff, Pickhardt and Co., Inc., New York. The nitrogen found was 15.26 per cent, equivalent to 18.55 per cent ammonia. It was sold under a guaranty of 15 per cent nitrogen, 18.2 per cent ammonia.

CASTOR POMACE.

Castor pomace is the ground residue left after the removal of oil from the castor bean. It should be stored out of reach of farm animals, as it is very poisonous. The material is chiefly valuable as a source of nitrogen, although, like other vegetable ammoniates, cottonseed meal and linseed meal, it contains small amounts of phosphoric acid and potash.

Seventy-four samples have been analyzed. Fifteen were taken officially by the Station agent and the remainder were sampled and submitted by the purchasers.

The material was found to be of very satisfactory quality, only four samples showing less than the guaranteed amount of nitrogen, and these deficiencies did not exceed ¼ of 1 per cent. These goods are generally sold on a guaranty of 4.5 per cent of nitrogen, and the average nitrogen for all the samples examined is 4.80 per cent.

Prices quoted have ranged from $21.50 to $30.00 per ton, which makes the cost of nitrogen about 24 cents per pound.

Analyses are given in Table III.

TABLE III. ANALYSES OF CASTOR POMACE

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen Found.
	The American Agricultural Chemical Co., New York City.		
6684	....	Station agent, from stock of Frank Seeman, Milford............	4.36
6945	....	Station agent, from stock of T. J. Barrisford, West Suffield......	4.64
7397	....	Station agent, from stock of Frank Seeman, Milford............	4.54
	Apothecaries Hall Co., Waterbury, Conn.		
6621	....	Station agent, from factory......	4.50
6165	Car No. 79553............	Hatheway & Steane, Inc., Hartford......................	4.52
6341	Car No. 36425............	Hatheway & Steane, Inc., Hartford......................	5.09
6366	Car No. 20094............	Hatheway & Steane, Inc., Hartford......................	4.63
6367	Car No. 17835............	Hatheway & Steane, Inc., Hartford......................	4.99
6370	Car No. 17786............	Hatheway & Steane, Inc., Hartford......................	5.21
6872	Car No. 17776............	Hatheway & Steane, Inc., Hartford......................	5.50
7145	Car No. N. H. 73843........	A. N. Shepard & Sons, Hartford..	5.28
	Armour Fertilizer Works, New York City.		
6825	....	Station agent, from stock of Geo. S. Phelps & Co., Thompsonville	5.00
	Baker Castor Oil Co., New York City.		
5526	Car No. 10534............	American Sumatra Tobacco Co., Bloomfield.................	4.76
5527	Car No. 215961...........	American Sumatra Tobacco Co., Bloomfield.................	4.84
5528	Car No. 16446............	American Sumatra Tobacco Co., Bloomfield.................	4.77
5529	Car No. 27497............	American Sumatra Tobacco Co., Bloomfield.................	4.54
5530	Car No. 39553............	American Sumatra Tobacco Co., Bloomfield.................	4.78
5612	Car No. 33449............	American Sumatra Tobacco Co., Bloomfield.................	4.67

TABLE III. ANALYSES OF CASTOR POMACE— *Continued*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per c[ent] Nitro[gen] Found.
	Baker Castor Oil Co., New York City		
5613	Car No. 517497	American Sumatra Tobacco Co., Bloomfield	4.74
5614	Car No. 75043	American Sumatra Tobacco Co., Bloomfield	4.60
5869	Car No. 597157	American Sumatra Tobacco Co., Bloomfield	4.82
5949	Car No. 531097	American Sumatra Tobacco Co., Bloomfield	4.71
5950	Car No. 86131	American Sumatra Tobacco Co., Bloomfield	4.83
5951	Car No. 17021	American Sumatra Tobacco Co., Bloomfield	4.49
6036	Car No. 290232	American Sumatra Tobacco Co., Bloomfield	4.81
6037	Car No. 90385	American Sumatra Tobacco Co., Bloomfield	4.68
6038	Car No. 510771	American Sumatra Tobacco Co., Bloomfield	4.82
6075	Car No. 35119	American Sumatra Tobacco Co., Bloomfield	4.89
6213	Car No. 559133	American Sumatra Tobacco Co., Bloomfield	5.74
6214	Car No. 568368	American Sumatra Tobacco Co., Bloomfield	5.08
6215	Car No. 95103	American Sumatra Tobacco Co., Bloomfield	5.34
6216	Car No. 23648	American Sumatra Tobacco Co., Bloomfield	5.57
6217	Car No. 76281	American Sumatra Tobacco Co., Bloomfield	5.16
6220	Car No. 33987	American Sumatra Tobacco Co., Bloomffeld	4.65
6240	Car No. 560608	American Sumatra Tobacco Co., Bloomfield	5.34
6950	Car No. 35119	American Sumatra Tobacco Co., Bloomfield	4.88
6678		Station agent, from stock of Silberman & Kahn, Hartford	4.42
7344		Station agent, from stock of Rogers & Hubbard, Portland	4.96
7389		J. E. Phelps, Suffield	4.51

TABLE III. ANALYSES OF CASTOR POMACE—*Continued.*

Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
Berkshire Chemical Co., Bridgeport, Conn.			
....	E. N. & C. C. Austin, Suffield....	4.86	4.52
....	L. B. Haas & Co., Hartford.....	4.50	4.52
Car No. 35351............	Conn. Sumatra Tobacco Co., Buckland..................	4.43	4.52
Car No. 35351............	Conn. Sumatra Tobacco Co., Buckland..................	4.55	4.52
Car Nos. 72453 and 62697...	Conn. Sumatra Tobacco Co., Buckland..................	4.50	4.52
Car Nos. 72453 and 62697...	Conn. Sumatra Tobacco Co., Buckland..................	4.58	4.52
Car Nos. 72453 and 62697...	Conn . Sumatra Tobacco Co., Buckland..................	4.25	4.52
Car Nos. 72453 and 62697...	Conn. Sumatra Tobacco Co., Buckland..................	4.34	4.52
Car No. 80193............	Conn. Sumatra Tobacco Co., Buckland..................	4.40	4.52
Car No. 80193............	Conn. Sumatra Tobacco Co., Buckland..................	4.70	4.52
Car No. 23331............	Hatheway & Steane Inc., Hartford........................	4.49	4.52
....	Station agent, from stock of L. B. Haas & Co., Hartford.........	4.57	4.52
....	Charles A. Huntington, Windsor..	4.21	4.52
Car No. N. Y. 84948........	Spencer Bros., Inc., Suffield......	4.66	4.52
....	W. S. Pinney, Suffield..........	4.61	4.52
....	George F. King, Suffield.........	4.28	4.52
....	Station agent, from stock of E. N. Austin, Suffield..............	4.86	4.52
....	Station agent, from stock of T. W. Ryan, Stratford.............	4.94	4.52
E. D. Chittenden Co., Bridgeport, Conn.			
....	Station agent, from stock of P. F. Chamberlain, Broad Brook....	4.54	4.50
Consolidated Rendering Co., Boston, Mass.			
....	Station agent, from stock of Fred Getto, Glastonbury...........	4.92	4.52
....	Station agent, from stock of Arthur Manning, Manchester..	4.52	4.52

TABLE III. ANALYSES OF CASTOR POMACE—*Concluded.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Old Deerfield Fertz. Co., Inc., South Deerfield, Mass.			
6352	....	The Allied Tobacco Co., Hartford.	4.83	4.52
6496	Car No. 231910.............	The Allied Tobacco Co., Hartford.	5.14	4.52
6497	Car No. 226655, N. Y. C......	The Allied Tobacco Co., Hartford.	5.30	4.52
6556	Car No. 247357.............	The Allied Tobacco Co., Hartford.	4.45	4.52
	Olds & Whipple, Inc., Hartford, Conn.			
6695	....	Station agent, from factory......	4.74	....
7031	....	Station agent at factory.........	5.22	5.00
7531	....	John M. Herr, Burnside.........	5.13	5.00
7041	Thum No. 1................	Henry E. Wells, Warehouse Point.	5.45	5.00
7042	Thum No. 2................	Henry E. Wells, Warehouse Point.	5.12	5.00
	The Rogers & Hubbard Co., Portland, Conn.			
7170	....	George F. King, Suffield.........	5.31	....
	Silberman & Kahn, Hartford, Conn.			
5902	Car No. 13763.............	American Sumatra Tobacco Co., Bloomfield..................	5.03	....
	Manufacturer Unknown			
7029	....	Marcus Floyd, Hartford.........	4.52	....
7512	....	Joe Pavano, Plainville..........	5.02	....
6333	....	Truman H. Hale, Gildersleeve....	4.64	....

COTTONSEED MEAL.

The quality of cottonseed meal purchased for fertilizer during the year is shown by the following summary:

Grade.	No. of samples	Average nitrogen per cent	Average nitrogen, per cent, in 1926	1925	1924
36 per cent protein (5.76 N.)........	12	5.78	5.84	5.87	5.79
41 per cent protein (6.58 N.)........	88	6.56	6.60	6.65	6.76
43 per cent protein (6.88 N.)........	31	7.05	6.78	6.87	7.02
No guaranty reported	43	6.64	...	...	...
Total	174	6.61	...	...	...

Of one hundred and thirty-one samples for which guaranties were given, one hundred and nine substantially equalled or exceeded their guaranties and twenty-two did not.

As for several years past, most of the samples were of the 41 per cent protein grade.

The 43 per cent grade of meal was the only one of the three grades to show any substantial overrun in nitrogen.

In the last four years the nitrogen content of the three grades of meal has remained fairly uniform; however, the 41 per cent grade has shown a slight but constant decrease.

The average nitrogen content of all samples is 6.61 per cent, which is a 41 per cent protein grade.

So far as ton price quotations are available the range has been from $33.50 to $45.00; the average, based on 67 quotations, is $37.00. The cost per pound of nitrogen is 27.8 cents, which is the lowest in several years.

Analyses are given in Table IV.

LINSEED MEAL.

Eight samples of linseed meal were analyzed and all were of good quality. The average nitrogen content is 5.75 per cent. The average of seven price quotations is $47.00 and the cost of nitrogen from this source has been about 41 cents per pound.

Analyses are given in Table IV.

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS.

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	American Agricultural Chemical Co., New York	**Cottonseed Meal**		
7475	....	Station agent at factory, West Haven......................	7.05	6.58
	Armour Fertilizer Works, New York.			
6881	Armour's 8%.............	Station agent, f.om stock of Jacob Bantly, Glastonbury..........	6.65	6.58
7495	Armour's 8%.............	Nicholas Schug, Burnside.......	6.62	6.58
	Ashcraft-Wilkinson Co., Atlanta, Ga.			
5531	Car No. 22204............	American Sumatra Tobacco Co., Bloomfield.................	6.95	....
5616	Car No. 48134............	American Sumatra Tobacco Co., Bloomfield.................	6.81	....
5026	Paramount, Car No. A. C. L., 35862..................	The Coles Company, Middletown.	5.14	5.76
6152	No. 15, Car Nos. 89224-71886-81058, (Schumacher Oil Works).................	Conn. Sumatra Tobacco Co., Buckland..................	7.21	....
6153	No. 16, Car Nos. 89224-71886-81058, (Schumacher Oil Works).................	Conn. Sumatra Tobacco Co., Buckland..................	6.98	....
6154	No. 17, Car Nos. 89224-71886-81058, (Schumacher Oil Works).................	Conn. Sumatra Tobacco Co., Buckland..................	7.24	....
6155	No. 18, Car Nos. 89224-71886-81058, (Schumacher Oil Works).................	Conn. Sumatra Tobacco Co., Buckland..................	7.18	....
6156	No. 19, Car Nos. 89224-71886-81058, (Schumacher Oil Works)...................	Conn. Sumatra Tobacco Co., Buckland..................	7.61	....
6157	No. 20, Car Nos. 89224-71886-81058, (Schumacher Oil Works).................	Conn. Sumatra Tobacco Co., Buckland..................	6.75	....
6144	No. 7, Car No. 75212, (So. Texas Cotton Oil Co.).....	Conn. Sumatra Tobacco Co., Buckland..................	6.95	....
6145	No. 8, Car No. 75212, (So. Texas Cotton Oil Co.).....	Conn. Sumatra Tobacco Co., Buckland..................	7.00	....
6146	No. 9, Car No. 75212, (So. Texas Cotton Oil Co.).....	Conn. Sumatra Tobacco Co., Buckland..................	6.76	....
6147	No. 10, Car No. 75212, (So. Texas Cotton Oil Co.).....	Conn. Sumatra Tobacco Co., Buckland..................	7.24	....
5977	Car No. 76128............	L. B. Haas & Co., Inc., Hartford..	7.62	....

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed
	Ashcraft-Wilkinson Co., Atlanta, Ga.	**Cottonseed Meal.**		
4	Helmet, Lot 1	E. G. Hastings, Suffield	6.77	6.58
5	Helmet, Lot 2	E. G. Hastings, Suffield	6.72	6.58
6	Monarch, Car No. A.C.L. 47316	Spencer Bros., Suffield	7.05	6.88
0	Monarch, Car No. A.C.L. 48532	Spencer Bros., Suffield	7.11	6.88
1	Helmet, Car No. S. A. L. 85058	Spencer Bros., Suffield	5.74	6.58
2	Helmet, Car No. N. S. 4232	Spencer Bros., Suffield	6.05	6.58
3	Paramount, Car No. Ga. 19026	Spencer Bros., Suffield	5.89	5.76
5	Paramount, Car No. Ga. 7795	Spencer Bros., Suffield	5.84	5.76
6	Paramount, Car No. Ga. 18586	Spencer Bros., Suffield	5.98	5.76
7	Helmet, Car No. A. C. L. 38286	Spencer Bros., Suffield	6.81	6.58
0	Helmet, Car No. N. S. 20923	Spencer Bros., Inc., Suffield	6.59	6.58
1	Helmet, Car No. N. S. 4358	Spencer Bros., Inc., Suffield	6.32	6.58
8	Paramount, Car No. A. C. L. 35483	Spencer Bros., Inc., Suffield	5.88	5.76
9	Paramount, Car No. S. A. L. 10918	Spencer Bros., Inc., Suffield	5.73	5.76
0	Paramount, Car No. S. L. S. F. 127137	Spencer Bros., Inc., Suffield	5.58	5.76
1	Monarch, Car No. M. C. 35205	Steane, Hartman & Co., Hartford	7.59	6.88
2	Monarch, Car No. N. Y. N. H. & H. 86622	Steane, Hartman & Co., Hartford	7.50	6.88
2	Monarch, Car No. N. Y. N. H. & H. 89889	Steane, Hartman & Co., Hartford	7.50	6.88
3	Monarch, Car No. P. R. R. 19644	Steane, Hartman & Co., Hartford	7.67	6.88
1	Paramount	Station agent, from stock of John Sullivan & Son, Thompsonville	5.88	5.76
4	Monarch, Car No. M. C. 8829	Oliver J. Thrall, Windsor	7.74	6.88
5	Monarch, Car No. N. H. 80382	Oliver J. Thrall, Windsor	7.70	6.88
6	Monarch, Car No. H. & T. C. 84975	Oliver J. Thrall, Windsor	7.69	6.88
7	Monarch, Car No. N. H. 74649	Oliver J. Thrall, Windsor	7.57	6.88
	The Berg Company, Philadelphia, Pa.			
2	....	The Conn. Sumatra Tobacco Co., Buckland	6.65	....
	F. W. Brode Corp., Memphis, Tenn.			
7	Owl Brand	Station agent, from stock of Jos. Rostek, Jr., Melrose	6.70	6.56
1	Owl Brand	Station agent, from stock of L. P. M. Hickey, East Hartford	6.57	6.56

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	F. W. Brode Corp., Memphis, Tenn.	**Cottonseed Meal.**		
7171	Owl Brand	Geo. S. Phelps & Co., Thompsonville	6.53	6.56
7172	Owl Brand, Car No. P. & O. 195770	Geo. S. Phelps & Co., Thompsonville	6.72	6.56
7247	Owl Brand, No. 1	A. L. Koster, West Hartford	6.60	6.56
7248	Owl Brand, No. 2	A. L. Koster, West Hartford	6.68	6.56
7249	Owl Brand, No. 3	A. L. Koster, West Hartford	6.91	6.56
7341	Owl Brand	Station agent, from stock of E. N. Austin, Suffield	6.80	6.56
	Humphreys-Godwin Co., Memphis, Tenn.			
5813	Car No. 31497	American Sumatra Tobacco Co., Bloomfield	6.38	....
5814	Car No. 55077	American Sumatra Tobacco Co., Bloomfield	7.85	....
5615	Car No. 77630	American Sumatra Tobacco Co., Bloomfield	6.79	....
5227	Dixie Brand, Car No. 31227	American Sumatra Tobacco Co., Bloomfield	6.44	6.58
5728	Dixie Brand, Car No. 25778	American Sumatra Tobacco Co., Bloomfield	6.60	6.58
5729	Dixie Brand, Car No. 83936	American Sumatra Tobacco Co., Bloomfield	6.20	6.58
5730	Dixie Brand, Car No. 25491	American Sumatra Tobacco Co., Bloomfield	6.58	6.58
5765	Dixie Brand, Car No. 58366	American Sumatra Tobacco Co., Bloomfield	6.49	6.58
5766	Dixie Brand, Car No. 84201	American Sumatra Tobacco Co., Bloomfield	6.82	6.58
5767	Dixie Brand, Car No. 85717	American Sumatra Tobacco Co., Bloomfield	6.34	6.58
5768	Dixie Brand, Car No. 56629	American Sumatra Tobacco Co., Bloomfield	6.50	6.58
5770	Dixie Brand, Car No. 72137	American Sumatra Tobacco Co., Bloomfield	6.50	6.58
5771	Dixie Brand, Car No. 80162	American Sumatra Tobacco Co., Bloomfield	6.55	6.58
5772	Dixie Brand, Car No. 17706	American Sumatra Tobacco Co., Bloomfield	6.27	6.58
5773	Dixie Brand, Car No. 87848	American Sumatra Tobacco Co., Bloomfield	6.60	6.58
5774	Dixie Brand, Car No. 7367	American Sumatra Tobacco Co., Bloomfield	6.46	6.58

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

Manufacturer or Jobber. Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
Humphreys-Godwin Co., Memphis, Tenn.	**Cottonseed Meal.**		
Dixie Brand, Car No. 55588	American Sumatra Tobacco Co., Bloomfield	6.47	6.58
Dixie Brand, Car No. 4869	American Sumatra Tobacco Co., Bloomfield	6.45	6.58
Dixie Brand, Car No. 28254	American Sumatra Tobacco Co., Bloomfield	6.82	6.58
Dixie Brand, Car No. 50752	American Sumatra Tobacco Co., Bloomfield	6.49	6.58
Car No. 40100	American Sumatra Tobacco Co., Bloomfield	6.62	....
Dixie Brand, Car No. P. McK & Y 80227	L. B. Haas & Co., Inc., Hartford	6.58	6.58
Dixie Brand, Car No. C & N. W. 47160	L. B. Haas & Co., Inc., Hartford	6.31	6.58
Car No. 167624	Hatheway & Steane, Inc., Hartford	6.30	....
Car No. 164639	Hatheway & Steane, Inc., Hartford	6.11	....
Car No. 170897	Hatheway & Steane, Inc., Hartford	6.69	....
Car No. 57015	Hatheway & Steane, Inc., Hartford	6.36	....
Car No. 248430	Hatheway & Steane, Inc., Hartford	6.71	....
Car No. 159489	Hatheway & Steane, Inc., Hartford	6.66	....
Car No. 10561	Hatheway & Steane, Inc., Hartford	6.60	....
Car No. 15846	Hatheway & Steane, Inc., Hartford	6.34	....
Car No. 226504	Hatheway & Steane, Inc., Hartford	6.65	....
Car No. 82078	Hatheway & Steane, Inc., Hartford	6.69	....
Dixie Brand, Car No. 709598	Hatheway & Steane, Inc., Hartford	6.64	6.58
Dixie Brand, Car No. 56341	Hatheway & Steane, Inc., Hartford	6.33	6.58
Dixie Brand	A. N. Shepard & Son, Hartford	6.66	6.58
Dixie Brand	A. N. Shepard & Son, Hartford	6.66	6.58
Dixie Brand	Station agent, from stock of Silberman & Kahn, Hartford	6.48	6.58
Bull Brand	Station agent, from stock of Spencer Bros., Inc., Suffield	6.99	6.88
Bull Brand, Car Southern 409401	Spencer Bros., Inc., Suffield	6.93	6.88
Bull Brand, Car Southern 150389	Spencer Bros., Inc., Suffield	6.97	6.88
Bull Brand, S. F. 14526	Spencer Bros., Inc., Suffield	6.76	6.88
Bull Brand, I. C. 330213	Spencer Bros., Inc., Suffield	6.88	6.88
Bull Brand, C. B. & Q. 131837	Spencer Bros., Inc., Suffield	6.93	6.88
Bull Brand, I. C. 340615	Spencer Bros., Inc., Suffield	7.02	6.88
Bull Brand, I. C. 342716	Spencer Bros., Inc., Suffield	6.89	6.88
M. C. 98467	Spencer Bros., Inc., Suffield	6.82	6.88
Bull Brand, Southern 253511	Spencer Bros., Inc., Suffield	6.91	6.88

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark.	Purchased, Sampled or Sent by	Per cent. Nitrogen.	
			Found.	Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.	**Cottonseed Meal.**		
7105	Dixie Brand, Car No. I. C. 156222	Spencer Bros., Inc., Suffield	6.40	6.58
7106	Dixie Brand, Car No. M. C. 52571	Spencer Bros., Inc., Suffield	6.64	6.58
7107	Dixie Brand, Car No. M. C. 99982	Spencer Bros., Inc., Suffield	6.40	6.58
7108	Dixie Brand, Car No. I. C. 155718	Spencer Bros., Inc., Suffield	6.38	6.58
7109	Dixie Brand, Car No. I. C. 247162	Spencer Bros., Inc., Suffield	6.67	6.58
7110	Dixie Brand, Car No. Ga. 51411	Spencer Bros., Inc., Suffield	6.55	6.58
7114	Dixie Brand, Car No. A. C. L. 17546	Spencer Bros., Inc., Suffield	6.67	6.58
7118	Bull Brand, Car No. I. C. 223252	Spencer Bros., Inc., Suffield	6.77	6.88
7119	Dixie Brand, Car No. So. 164943	Spencer Bros., Inc., Suffield	6.74	6.58
7122	Dixie Brand, Car No. Ga. 55952	Spencer Bros., Inc., Suffield	6.47	6.58
7123	Dixie Brand, Car No. I. C. 247864	Spencer Bros., Inc., Suffield	6.48	6.58
7124	Dixie Brand, Car No. P. & E. 3560	Spencer Bros., Inc., Suffield	6.60	6.58
7201	Dixie Brand, Car No. N. Y. C. 245186	Spencer Bros., Inc., Suffield	6.65	6.58
6101	Dixie Brand, Car No. P. & L. C. 45772	Steane, Hartman & Co., Hartford	6.52	6.58
6102	Dixie Brand, Car No. C. C. C. & St. L 54234	Steane, Hartman & Co., Hartford	6.64	6.58
6103	Dixie Brand, Car No. P. & C. 33168	Steane, Hartman & Co., Hartford	6.42	6.58
6329	Dixie Brand, Car No. A. C. L. 29639	Steane, Hartman & Co., Hartford	6.79	6.58
6330	Dixie Brand, Car No. A. C. L. 43009	Steane, Hartman & Co., Hartford	6.61	6.58
6331	Dixie Brand, Car No. C. C. C. & St. L. 45262	Steane, Hartman & Co., Hartford	6.66	6.58
7013	Dixie Brand, Car No. 19058	L. Wetstone & Sons, Inc., Hartford	6.48	6.58
7014	Dixie Brand, Car No. 21413	L. Wetstone & Sons, Inc., Hartford	6.75	6.58
7015	Dixie Brand, Car No. 42832	L. Wetstone & Sons, Inc., Hartford	6.39	6.58
7016	Dixie Brand, Car No. 31042	L. Wetstone & Sons, Inc., Hartford	6.68	6.58
7017	Dixie Brand, Car No. 84717	L. Wetstone & Sons, Inc., Hartford	6.77	6.58
7018	Dixie Brand, Car No. 51094	L. Wetstone & Sons, Inc., Hartford	6.67	6.58

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

Station No.	Manufacturer or Jobber Car No. or Mark.	Purchased, Sampled or Sent by	Per cent Nitrogen. Found	Per cent Nitrogen. Guaranteed.
	Humphreys-Godwin Co., Memphis, Tenn.	**Cottonseed Meal.**		
7019	Dixie Brand, Car No. 86232 . .	L. Wetstone & Sons, Inc., Hartford	6.68	6.58
7020	Dixie Brand, Car No. 5615 . . .	L. Wetstone & Sons, Inc., Hartford	6.53	6.58
7230	Dixie Brand, Car No. 163931 .	L. Wetstone & Sons, Inc., Hartford	6.69	6.58
6871	Car No. 92703.	Hatheway & Steane, Inc., Hartford	6.33	. . . .
7391	Dixie Brand.	J. E. Phelps, Suffield.	6.63	6.58
7009	Car No. 135931.	Hatheway & Steane, Inc., Hartford	6.47	. . . .
5764	Bull Brand.	Lawton, Miner & Co., Unionville.	7.02	6.88
7421	Dixie Bra	Station agent, from stock of Geo. A. Peckham, Suffield.	6.38	6.58
6885	Danish Brand.	Station agent, from stock of S. J. Orr, West Suffield.	6.38	5.76
	International Agricultural Corp., Woburn, Mass.			
6947	43%.	Huntington Bros., Windsor.	6.68	6.88
6952	43%.	Huntington Bros., Windsor.	6.75	6.88
6973	43%, Car No. 62225.	L. B. Haas & Co., Inc., Hartford . .	6.43	6.88
7167	43%, Car No. 15852.	L. B. Haas & Co., Inc., Hartford . .	6.42	6.88
7168	43%, Car No. 75741.	L. B. Haas & Co., Inc., Hartford . .	6.78	6.88
7072	International Rainbow.	Arthur E. Pascoe, Warehouse Point.	5.68	5.76
7089	International Rainbow.	Station agent, from stock of Geo. S. Phelps & Co., Thompsonville.	5.58	5.76
6550	Zenith, Car No. 67271.	Allied Tobacco Co., Hartford.	6.68	6.56
6555	Zenith, Car No. 66785.	Allied Tobacco Co., Hartford.	6.67	6.56
6557	Zenith, Car No. 63710.	Allied Tobacco Co., Hartford.	6.44	6.56
6558	Zenith, Car No. 66278.	Allied Tobacco Co., Hartford.	6.57	6.56
6559	Zenith, Car No. 62016.	Allied Tobacco Co., Hartford.	6.68	6.56
6910	Zenith, Car No. Ga. 7055.	Allied Tobacco Co., Hartford.	6.61	6.56
6911	Zenith, Car No. 10925.	Allied Tobacco Co., Hartford.	6.53	6.56
6912	Zenith, Car No. 562078.	Allied Tobacco Co., Hartford.	6.55	6.56
	Spencer Kellogg & Son, Buffalo, N. Y.			
6342	Car No. 48246.	Hatheway & Steane, Inc., Hartford	6.64	6.56
	L. B. Lovitt & Co., Memphis, Tenn.			
7154	Lovit Brand 41%.	Station agent, from stock of Berkshire Chemical Co., Bridgeport. .	6.25	6.56
7268	Lovit Brand 41%.	C. D. Cannon, Windsor Locks. . . .	7.05	6.56
7160	Lovit Brand 43%.	Station agent, from stock of Dayville Coal & Grain Co., Putnam.	6.76	6.88
6301	Car S. P. 17175.	S. F. Holcomb & Son, W. Granby.	6.71	. . . .

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Continued.*

Station No.	Manufacturer or Jobber, Car No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	L. B. Lovitt Co., Memphis, Tenn.	**Cottonseed Meal**		
6223	Car No. M. O. P. 27777	N. E. Kendall & Son, Granby	6.70	....
6029	Lovit Brand 43%, Car No. U. P. 19498	Spencer Bros., Inc., Suffield	6.99	6.8
6030	Lovit Brand 43%, Car No. I. C. 246483	Spencer Bros., Inc., Suffield	6.97	6.8
6857	Lovit Brand 41%, Car No. M. & O. 20875	Spencer Bros., Inc., Suffield	6.64	6.5
6859	Lovit Brand 41%, Car No. A. C. L. 28060	Spencer Bros., Inc., Suffield	6.50	6.5
7560	....	Berkshire Chemical Co., Bridgeport	6.53	...
	Marianna Sales Co., Memphis, Tenn.			
5608	Car No. A. C. L. 40777	The Coles Company, Middletown	5.75	5.7
	Memphis Cottonseed Products Co., Memphis, Tenn.			
7134	Durham 41%	Hartz Bros., Burnside	6.54	6.5
6672	Durham 43%	John F. Luddy, Elmrose Farm, Hazardville	6.89	6.8
	R. N. Neal & Son, Memphis, Tenn.			
6551	"Triangle" Brand 41%, Car No. 20476	The Allied Tobacco Co., Hartford	6.49	6.5
6552	"Triangle" Brand 41%, Car No. 335912	The Allied Tobacco Co., Hartford	5.95	6.5
6553	"Triangle" Brand 41%, Car No. 47285	The Allied Tobacco Co., Hartford	6.32	6.5
	Manufacturer Unknown.			
6554	Car No. 67729	Allied Tobacco Co., Hartford	6.81	...
6907	No. 1	F. Albert Carlson, New Milford	6.79	...
6908	No. 2	F. Albert Carlson, New Milford	6.67	...
6369	Car No. 34896	Hatheway & Steane, Inc., Hartford	6.54	...
6373	Car No. 109217	Hatheway & Steane, Inc., Hartford	6.87	...
7007	Car No. 4059	Hatheway & Steane, Inc., Hartford	6.51	...
7023	....	Marcus Floyd, Hartford	7.11	...
7024	....	Marcus Floyd, Hartford	6.65	...
7025	....	Marcus Floyd, Hartford	7.00	...
7026	....	Marcus Floyd, Hartford	6.58	...

TABLE IV. ANALYSES OF COTTONSEED AND LINSEED MEALS—*Concluded.*

Station No.	Manufacturer or Jobber, Car. No. or Mark	Purchased, Sampled or Sent by	Per cent. Nitrogen. Found.	Per cent. Nitrogen. Guaranteed.
	Spencer Kellogg & Son, Buffalo, N. Y.	**Linseed Meal.**		
7500	....	Station agent, from stock of Apothecaries Hall Co., East Windsor....................	5.47	5.44
6293	Car No. 84219..............	Hatheway & Steane, Inc., Hartford	5.76	5.44
6295	Car No. 9499...............	Hatheway & Steane, Inc., Hartford	5.83	5.44
6298	*Car No. 8408...............*	*Hatheway & Steane, Inc., Hartford*	*5.79*	*5.44*
6340	Car No. 38957..............	Hatheway & Steane, Inc., Hartford	5.72	5.44
7138	Car No. N. H. 92027........	A. N. Shepard & Son, Hartford...	5.68	5.44
	Manufacturer Unknown.			
6365	Car No. 8044...............	Hatheway & Steane, Inc., Hartford	5.89	....
6378	Car No. 38395..............	Hatheway & Steane, Inc., Hartford	5.84	....

II. RAW MATERIALS CHIEFLY VALUABLE FOR PHOSPHORIC ACID.

PRECIPITATED BONE PHOSPHATE.

This material is a by-product in the manufacture of gelatin and practically all of the phosphoric acid in it is in the "available" form.

Eight samples were analyzed and all were of good quality, although two fell a little short of their guaranties.

Available phosphoric acid from this source has cost about 5.6 cents per pound so far as can be estimated from the prices quoted.

Analyses are given in Table V.

TABLE V. ANALYSES OF PRECIPITATED BONE PHOSPHATE.

Station No.	Manufacturer or Wholesale Dealer	Place of Sampling	Phosphoric Acid			
			Citrate-insoluble.	Total	"Available" Found	"Available" Guaranteed.
			%	%	%	%
	Sampled by Station.					
6616	Apothecaries Hall Co., Waterbury..........	At factory......................	0.84	42.32	41.48	36.00
6640	Berkshire Chemical Co., Bridgeport.........	At factory.....................	0.48	38.24	37.76	38.00
6694	Olds & Whipple, Inc., Hartford............	At factory......................	0.32	37.94	37.62	38.00
	Sampled by Purchaser.					
7028	....	Marcus Floyd, Hartford..........	0.60	39.00	38.40	....
6289	Apothecaries Hall Co., Waterbury, Car No. 88276............................	Hatheway & Steane, Inc., Hartford	0.85	42.12	41.27	36.00
6372	Apothecaries Hall Co., Waterbury, Car No. 1085.............................	Hatheway & Steane, Inc., Hartford	0.73	42.80	42.07	36.00
7527	Olds & Whipple, Inc., Hartford............	John M. Herr, Burnside..........	0.70	41.90	41.20	38.00
5067	Olds & Whipple, Inc., Hartford............	John B. Stewart, Windsor........	1.49	43.16	41.67	38.00

SUPERPHOSPHATE (ACID PHOSPHATE).

This important raw material is made by treating finely ground phosphate rock with sulphuric acid. The mixture while still in a fluid condition is run into tanks called "hot dens", where it soon solidifies, after which it is broken up and pulverized to make it suitable for use in fertilizer mixtures.

Superphosphate is a mixture of calcium phosphate (soluble mono-calcium phosphate), and calcium sulphate (gypsum). It contains 16 per cent or more of available phosphoric acid.

Twenty-two samples were analyzed and all met their guaranties with two exceptions, where deficiencies of about 0.4 per cent were found.

The average available phosphoric acid found this year is 16.87 per cent. The average of prices quoted is $20.70 and available acid has therefore cost about 6.2 cents per pound in this raw material.

Analyses are given in Table VI.

TABLE VI. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE).

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. "Available." Found.	Phosphoric Acid. "Available." Guaranteed.	Station No.
	Sampled by Station.		%	%	%	%	
6615	American Agricultural Chemical Co., New York	Suffield: Spencer Bros.	0.27	16.94	16.67	16.00	6615
6618	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor	0.88	17.11	16.23	16.00	6618
6815	Armour Fertz. Works, New York	Stamford: F. A. Bartlett Tree Expert Co.	0.65	20.85	20.20	20.00	6815
6696	Armour Fertz. Works, New York	Danbury: F. C. Benjamin	0.47	16.77	16.30	16.00	6696
6641	Berkshire Chemical Co., Bridgeport	Sampled at factory	0.13	17.58	17.45	16.00	6641
7219	E. D. Chittenden Co., Bridgeport	Broad Brook: Fred Schlichting	0.91	16.98	16.07	16.00	7219
6700	E. B. Clark Seed Co., Milford	Sampled at factory	0.24	15.83	15.59	16.00	6700
6652	Consolidated Rendering Co., Boston, Mass.	Highwood: H. D. Peters	0.31	18.08	17.77	16.00	6652
6697	Eastern States Farmers' Exchange Springfield, Mass.	New Canaan: Stephen Hoyt & Sons.	0.22	16.76	16.54	16.00	6697
7151	International Agricultural Corp., Boston, Mass.	Willimantic: Willimantic Grain Co.	0.30	16.50	16.20	16.00	7151
6739	Olds & Whipple, Inc., Hartford	So. Manchester: F. T. Blish Hardware Co.	0.31	16.46	16.15	16.00	6739
7178	Piedmont Mt. Airy Guano Co., Baltimore, Md.	Plantsville: Mehmel & Sarvi	0.83	17.00	16.17	16.00	7178
6744	Rogers & Hubbard Co., Portland	Sampled at factory	0.30	18.40	18.10	16.00	6744

TABLE VI. ANALYSES OF SUPERPHOSPHATE (ACID PHOSPHATE)—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Phosphoric Acid.				Station No.
					"Available."		
			Citrate-insoluble.	Total.	Found.	Guaranteed.	
			%	%	%	%	
6844	F. S. Royster Guano Co., Baltimore, Md.	Thompsonville: Geo. S. Phelps & Co.	0.38	15.95	15.57	16.00	6844
7476	F. S. Royster Guano Co., Baltimore, Md.	Plainville: F. B. Newton	0.20	17.10	16.90	16.00	7476
6748	I. P. Thomas & Son Co., Philadelphia, Pa.	Guilford: F. C. Morse & Son	1.35	18.35	17.00	16.00	6748
6827	I. P. Thomas & Son Co., Philadelphia, Pa.	Talcottville: Lyman Bros.	1.20	17.80	16.60	16.00	6827
6921	Triton Oil & Fertilizer Co., New York	Colchester: Red Wing Feed & Lumber Co.	0.15	18.40	18.25	16.00	6921
7351	United States Guano Co., Baltimore, Md.	North Haven: E. O. Chapman	0.33	17.30	16.97	16.00	7351
7450	Wilcox Fertilizer Co., Mystic	Willimantic: Jordan Hardware Co.	0.20	17.25	17.05	16.00	7450
	Sampled by Purchaser.						
6955	Consolidated Rendering Co., Boston	Marion: Daigle Bros.	0.95	17.35	16.40	16.00	6955
7027	....	Hartford: Marcus Floyd	0.30	17.15	16.85	....	7027

III. RAW MATERIALS CHIEFLY VALUABLE FOR POTASH.

CARBONATE OF POTASH.

The commercial grades of carbonate of potash generally contain from 60 to 65 per cent of actual potash (K_2O). The pure and moisture-free salt contains 68.2 per cent K_2O.

Eleven samples of this material were analyzed, three of these being samples taken by the Station agent and the remainder being sampled and sent by purchasers.

The official samples contained well over 65 per cent of potash. Some of the samples submitted by purchasers tested somewhat under 60 per cent. The dealers, Apothecaries Hall Co., advise that their stock was purchased on a guaranty of 65 per cent, but for resale they made the guaranty 61 per cent to insure a margin of safety. The low results are explained by the fact that the goods as sampled contained more moisture than that upon which the original guaranty was based. Potassium carbonate absorbs moisture rather readily and while it may contain as little as 1 per cent or less, it is more likely to contain 5 to 10 per cent as the purchaser receives it. However, if the absorption of moisture takes place after the goods are packed the purchaser is not defrauded because he receives all the potash which was originally packed but in a somewhat more dilute form.

The average potash content in the samples examined is 63.8 per cent. Price quotations are so limited and so variable that an estimated cost per pound for potash is not very informing. According to valuations which we have used this year 11 cents per pound is the accepted figure for potash from this source.

Analyses are given in Table VII.

MURIATE OF POTASH.

Muriate of potash in commercial grades contains about 50.5 per cent of actual potash, which is equivalent to about 80 per cent pure potassium chloride. Guaranties for potash are usually placed at 48 to 50 per cent. The Association of Official Agricultural Chemists has accepted tentatively a standard of not less than 48 per cent potash for this salt.

The nine samples examined all exceeded their guaranties and the average potash content is 51.5 per cent. Potash from this source has cost about 4.6 cents per pound according to the average of quoted prices, viz., $46.00.

Analyses are given in Table VII.

SULPHATE OF POTASH.

This salt usually contains about 48 per cent of actual potash as offered for fertilizer purposes.

Twenty-two samples were analyzed, nine of which were officially drawn by the Station agent. All samples exceeded their guaranties, and the average potash content was slightly over 49.5 per cent. The cost per pound of potash at the average ton price, $53.70, is 5.4 cents.

Analyses are given in Table VII.

SULPHATE OF POTASH-MAGNESIA.

Only two samples of this salt were analyzed and both exceeded their guaranties, which were 26 per cent potash in both cases.

Analyses are given in Table VII.

COTTONHULL ASHES.

Twelve samples of cottonhull ashes have been analyzed. This material is very variable in composition, the potash content having ranged from less than 10 per cent to over 35 per cent. Last year it was found that low potash was associated with very high phosphoric acid content, about 30 per cent.

Analyses are given in Table VII.

WOOD ASHES.

Canada hard wood ashes are used in considerable quantities by tobacco growers in this State, purchases being made on the unit of potash basis. Besides potash wood ashes contain 1 to 3 per cent of phosphoric acid and 30 per cent or more of lime (CaO).

Fourteen samples were analyzed and all except No. **7566** were of good quality. Potash ranged from 4.6 to over 7 per cent.

Analyses are given in Table VII.

TABLE VII. ANALYSES OF POTASH SALTS, ETC.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Carbonate of Potash.				
	Sampled by Station:		%	%	
7157	Apothecaries Hall Co., Waterbury	Sampled at factory	67.01	61.00	7157
6675	A. Klipstein & Son, New York	Hartford: Silberman & Kahn	66.92	....	6675
6741	Olds & Whipple Inc., Hartford	Sampled at factory	65.98	65.00	6741
	Sampled by Purchaser:				
6868	Apothecaries Hall Co., Waterbury, Car No. 83283	Hatheway & Steane, Inc., Hartford	60.64	61.00	6868
6869	Apothecaries Hall Co., Waterbury, Car No. 10626	Hatheway & Steane, Inc., Hartford	59.16	61.00	6869
7008	Apothecaries Hall Co., Waterbury, Car No. 141927	Hatheway & Steane, Inc., Hartford	58.72	61.00	7008
7143	Apothecaries Hall Co., Waterbury, Car No. 73843	A. N. Shepard & Son, Hartford	64.78	61.00	7143
6221	A. Klipstein, New York	American Sumatra Tobacco Co., Bloomfield	65.70	....	6221
6804	Olds & Whipple, Inc., Hartford	L. B. Haas & Co., Hartford	65.16	65.00	6804
7390	Olds & Whipple, Inc., Hartford	J. E. Phelps, Suffield	66.11	65.00	7390
6626	W. S. Pinney, Suffield	P. J. Anderson: Tobacco Station, Windsor	61.88	....	6626
	Muriate of Potash.				
	Sampled by Station:				
7079	American Agricultural Chemical Co., New York	Sampled at factory, New Haven	51.72	50.00	7079
6620	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor	52.20	50.00	6620
6698	Armour Fertilizer Works, New York	Stamford: F. A. Bartlett Tree Expert Co.	51.90	48.00	6698
6638	Berkshire Chemical Co , Bridgeport	Sampled at factory	51.77	50.00	6638
7346	Berkshire Chemical Co., Bridgeport	E. N. Austin: Suffield	50.40	50.00	7349
6651	Consolidated Rendering Co., Boston, Mass.	H. D. Peters, Highwood	51.55	50.00	6651

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash Found.	Potash Guaranteed.	Station No.
	Muriate of Potash				
	Sampled by Station:		%	%	
7075	Eastern States Farmers' Exchange, Springfield, Mass.	Ridgewood Farm, North Haven	51.82	50.00	7075
6746	I. P. Thomas & Son Co., Philadelphia, Pa.	F. C. Morse & Son, Guilford	50.47	50.00	6746
	Sampled by Purchaser:				
6958	Consolidated Rendering Co., Boston, Mass.	Daigle Bros., Marion	51.70	50.00	6958
	Sulphate of Potash.				
	Sampled by Station:				
6614	American Agricultural Chemical Co., New York	Spencer Bros., Suffield	48.76	48.00	6614
6617	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor	50.85	48.00	6617
6923	Armour Fertilizer Works, New York	Jacob Bantly, Glastonbury	49.54	48.00	6923
6639	Berkshire Chemical Co., Bridgeport	Sampled at factory	49.04	48.00	6639
6636	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven	49.20	48.00	6636
7152	International Agricultural Corp., Boston, Mass.	Willimantic Grain Co., Willimantic	51.41	48.00	7152
7153	Mapes Formula & Peruvian Guano Co., New York	S. J. Orr, West Suffield	49.36	48.00	7153
6740	Olds & Whipple, Inc., Hartford	Sampled at factory	49.21	48.65	6740
6843	F. S. Royster Guano Co., Baltimore, Md.	Geo. S. Phelps & Co., Thompsonville	49.40	48.00	6843
	Sampled by Purchaser:				
6290	Apothecaries Hall Co., Waterbury, Car No. 88276	Hatheway & Steane, Inc., Hartford	50.96	48.00	6290
6299	Apothecaries Hall Co., Waterbury, Car No. 1095	Hatheway & Steane, Inc., Hartford	50.62	48.00	6299
6337	Apothecaries Hall Co., Waterbury, Truck No. 1090	Hatheway & Steane, Inc., Hartford	49.57	48.00	6337
6374	Apothecaries Hall Co., Waterbury, Car No. 78058	Hatheway & Steane, Inc., Hartford	50.20	48.00	6374

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found.	Potash. Guaranteed.	Station No.
	Sulphate of Potash. *Sampled by Purchaser:*		%	%	
6624	American Agricultural Chemical Co., New York	J. C. Dufford, Glastonbury	48.23	48.00	6624
7139	Apothecaries Hall Co., Waterbury, Car No. 92027	A. N. Shepard & Son, Hartford	50.25	48.00	7139
5532	Hollingshurst Co., New York, Car No. 100022	American Sumatra Tobacco Co., Bloomfield	47.76	....	5532
6142	Olds & Whipple, Inc., Hartford, No. 5	Conn. Sumatra Tobacco Co., Buckland	49.46	48.65	6142
6143	Olds & Whipple, Inc., Hartford, No. 6	Conn. Sumatra Tobacco Co., Buckland	49.80	48.65	6143
6160	Olds & Whipple, Inc., Hartford, No. 23	Conn. Sumatra Tobacco Co., Buckland	49.63	48.65	6160
6161	Olds & Whipple, Inc., Hartford, No. 24	Conn. Sumatra Tobacco Co., Buckland	49.79	48.65	6161
7387	Olds & Whipple, Inc., Hartford	J. E. Phelps, Suffield	49.47	48.65	7387
7528	Olds & Whipple, Inc., Hartford	John M. Herr, Burnside	48.26	48.65	7528
	Sulphate of Potash and Magnesia. *Sampled by Station:*				
7211	American Agricultural Chemical Co., New York	T. J. Barrisford, West Suffield	27.60	26.00	7211
6643	Apothecaries Hall Co., Waterbury	Sampled at factory, East Windsor	31.34	26.00	6643
	Cotton Hull Ashes. *Sampled by Station:*				
6875	Ed. Eggert, Hartford	American Agricultural Chemical Co., New Haven	31.19	....	6875
7088	Ed. Eggert, Hartford	Jos. Rostek, Jr., Melrose	33.79	....	7088
7342	Ed. Eggert, Hartford (Dixie)	Jos. Rostek, Jr., Melrose	9.48	13.00	7342
7343	Ed. Eggert, Hartford (Gayoso)	Jos. Rostek, Jr., Melrose	18.64	18.81	7343

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found	Potash. Guaranteed	Station No.
	Cotton Hull Ashes. *Sampled by Station:*		%	%	
7626	Ed. Eggert, Hartford	Jos. Rostek, Jr., Melrose	26.06	....	7626
7347	Ed. Eggert, Hartford, Car M. K. T. 84949	Spencer Bros., Suffield	24.22	24.25	7347
	Sampled by Purchaser:				
6631	Ed. Eggert, Hartford	Ed. Eggert, Hartford	33.95	....	6631
6630	Ed. Eggert, Hartford	Ed. Eggert, Hartford	36.76	....	6630
6987	Ed. Eggert, Hartford, Car No. 40493	Ed. Eggert, Hartford	25.23	....	6987
7564	Ed. Eggert, Hartford, Car No. 2272	Ed. Eggert, Hartford	27.38	....	7564
7565	Car No. 2295	Ed. Eggert, Hartford	12.72	....	7565
7022	....	Marcus Floyd, Hartford	21.78	....	7022
	Wood Ashes. *Sampled by Station:*				
6944	John Joynt, Lucknow, Canada	J. B. Rose, West Suffield	7.26	3.00	6944
6946	John Joynt, Lucknow, Canada	G. A. Peckham, Suffield	6.03	3.00	6946
6959	John Joynt, Lucknow, Canada	T. J. Clark Est., Simsbury	5.97	3.00	6959
6960	John Joynt, Lucknow, Canada	G. S. Potwine, Warehouse Point	6.88	3.00	6960
	Sampled by Purchaser:				
6287	John Joynt, Lucknow, Canada, Car No. 422783	Allied Tobacco Co., Hartford	6.09	3.00	6287
6288	John Joynt, Lucknow, Canada, Car No. 65215	Allied Tobacco Co., Hartford	4.57	3.00	6288
6364	John Joynt, Lucknow, Canada, Car No. 5187	Hatheway & Steane, Inc., Hartford	6.71	3.00	6364

TABLE VII. ANALYSES OF POTASH SALTS, ETC.—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Potash. Found	Potash. Guaranteed	Station No.
	Wood Ashes *Sampled by Purchaser:*		%	%	
6866	John Joynt, Lucknow, Canada, Car No. 8314......	Hatheway & Steane, Inc., Hartford......	6.92	3.00	6866
6867	John Joynt, Lucknow, Canada, Car No. 212783....	Hatheway & Steane, Inc., Hartford......	5.94	3.00	6867
7006	John Joynt, Lucknow, Canada, Car No. 67461.....	Hatheway & Steane, Inc., Hartford......	6.74	3.00	7006
7231	John Joynt, Lucknow, Canada, Car No. 62657.....	Ed. Eggert, Hartford..................	5.63	3.00	7231
7232	John Joynt, Lucknow, Canada, Car No. 60015.....	Ed. Eggert, Hartford..................	4.61	3.00	7232
7566	Car No. 2296.................................	Ed. Eggert, Hartford..................	1.82	....	7566
7233	John Joynt, Lucknow, Canada, Car No. 84756.....	Olds & Whipple, Inc., Hartford..........	5.49	3.00	7233

IV. RAW MATERIALS CONTAINING NITROGEN AND POTASH.

Five samples of this group of materials have been examined, three taken by the Station agent and two sent by purchasers.

Analyses are given in Table VIII.

7073. Nitrate of Soda and Potash. Apothecaries Hall Co., Waterbury. Sampled by Station agent, stock of B. H. Barnes, Waterbury.

6934. Nitrate of Soda and Potash. Wilcox Fertilizer Co., Mystic. Sampled by Station agent, stock of Jordan Hardware Co., Willimantic.

6163. Nitrate of Soda and Potash. W. R. Grace & Co., New York. Submitted by L. B. Haas & Co., Inc., Hartford.

6745. Nitrate of Potash. The Rogers & Hubbard Co., Portland. Sampled by Station agent at factory.

6083. Nitrate of Potash. The Rogers & Hubbard Co., Portland. Submitted by L. B. Haas & Co., Inc., Hartford.

TABLE VIII. ANALYSES OF NITRATE OF SODA AND POTASH, ETC.

Station No.	7073	6934	6163	6745	6083
	%	%	%	%	%
Nitrogen:					
found	14.90	14.81	14.16	14.58	14.52
guaranteed	14.80	14.72	....	11.50	30.98
Equivalent to ammonia:					
found	18.12	18.01	17.22	17.73	17.65
guaranteed	18.00	17.90	....	13.98	17.00
Potash:					
found	13.03	12.53	15.97	12.66	12.08
guaranteed	10.00	11.80	....	11.00	11.00

V. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

DRY GROUND FISH.

Dry ground fish or fish scrap is made from non-edible fish, such as menhaden and dogfish, and the offal from fish canneries. The fish are first steamed and pressed to remove oil and then dried and ground.

Thirty-four samples were analyzed, nine of which were sampled by the Station agent and the remainder sampled and submitted by purchasers.

Six samples showed considerable deficiencies in nitrogen. The guaranties for phosphoric acid were largely exceeded in most cases, but slight shortages were found in two samples.

The average nitrogen content found in this material this year is 8.5 per cent, and the average phosphoric acid content is 6.8 per cent. The average ton price, based on quotations reported, is about $64.00. Allowing 5 cents per pound for phosphoric acid, the cost of nitrogen per pound has been about 33.6 cents.

Analyses are given in Table IX.

TABLE IX. ANALYSES OF DRY GROUND FISH.

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total Guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Total found.	Phosphoric Acid. Total Guaranteed.	Station No.
	Sampled by Station:		%	%	%	%	%	
6659	American Agricultural Chemical Co., New York	F. S. Bidwell Co., Windsor Locks	8.61	8.23	10.47	8.29	6.00	6659
6674	Apothecaries Hall Co., Waterbury	Sampled at factory	8.50	8.20	10.34	7.12	5.00	6674
6924	Armour Fertilizer Works, New York	Jacob Bantley, Glastonbury	8.88	8.23	10.80	9.90	4.00	6924
6335	Berkshire Chemical Co., Bridgeport	L. B. Haas & Co., Hartford	8.39	8.22	10.20	5.92	6.00	6335
6693	Consolidated Rendering Co., Boston, Mass.	H. D. Peters, Highwood	8.23	8.22	10.01	9.18	6.40	6693
6900	Olds & Whipple, Inc., Hartford	Sampled at factory	9.44	8.23	11.48	7.28	5.00	6900
7443	F. S. Royster Guano Co., Baltimore, Md.	John Krancunas, Granby	8.34	8.22	10.14	6.48	3.50	7443
6935	Wilcox Fertilizer Co., Mystic	Sampled at factory	8.46	9.04	10.29	6.38	6.00	6935
7478	Wilcox Fertilizer Co., Mystic	Olds & Whipple, Inc., Hartford	8.20	9.04	9.97	7.55	6.00	7478
	Sampled by Purchaser:							
6622	American Agricultural Chemical Co., New York	J. C. Dufford, Glastonbury	8.70	8.23	10.58	8.10	6.00	6622
6166	Apothecaries Hall Co., Waterbury, Car No. 88690	Hatheway & Steane, Inc., Hartford	9.28	8.20	11.28	7.45	5.00	6166
6300	Apothecaries Hall Co., Waterbury, Car No. 1095	Hatheway & Steane, Inc., Hartford	9.19	8.20	11.17	7.56	5.00	6300

TABLE IX. ANALYSES OF DRY GROUND FISH—*Continued.*

Station No.	Manufacturer or Wholesale Dealer.	Dealer or Purchaser.	Nitrogen: Total found.	Nitrogen: Total Guaranteed.	Ammonia equivalent total nitrogen.	Phosphoric Acid: Total found.	Phosphoric Acid: Total Guaranteed.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	
6336	Apothecaries Hall Co., Waterbury, Truck No. 1092	Hatheway & Steane, Inc., Hartford	9.14	8.20	11.11	7.37	5.00	6336
6376	Apothecaries Hall Co., Waterbury, Car No. 78058	Hatheway & Steane, Inc., Hartford	8.92	8.20	10.84	8.06	5.00	6376
7141	Apothecaries Hall Co., Waterbury, Car No. 92027	A. N. Shepard & Son, Hartford	8.58	8.20	10.43	6.68	5.00	7141
5607	Atlantic Packing Co., New Haven	American Sumatra Tobacco Co., Bloomfield	7.68	8.23	9.34	4.87	....	5607
5610	Atlantic Packing Co., New Haven, Car No. 220794	American Sumatra Tobacco Co., Bloomfield	8.18	8.23	9.95	4.96	....	5610
5611	Atlantic Packing Co., New Haven, Car No. 30491	American Sumatra Tobacco Co., Bloomfield	8.10	8.23	9.85	4.86	....	5611
5621	Atlantic Packing Co., New Haven, Car No. 252740	American Sumatra Tobacco Co., Bloomfield	8.00	8.23	9.73	5.23	....	5621
5622	Atlantic Packing Co., New Haven, Car No. 32902	American Sumatra Tobacco Co., Bloomfield	8.46	8.23	10.29	5.32	....	5622
5725	Atlantic Packing Co., New Haven, Car No. 14689	American Sumatra Tobacco Co., Bloomfield	7.91	8.23	9.62	5.10	....	5725
5726	Atlantic Packing Co., New Haven, Car No. 14195	American Sumatra Tobacco Co., Bloomfield	8.22	8.23	9.99	4.97	....	5726

TABLE IX. ANALYSES OF DRY GROUND FISH—*Concluded.*

Station No.	Manufacturer or Wholesale Dealer	Dealer or Purchaser	Nitrogen. Total found	Nitrogen. Total guaranteed	Ammonia equivalent to total nitrogen	Phosphoric Acid. Total found.	Phosphoric Acid. Total guaranteed.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	
5810	Atlantic Packing Co., New Haven, Car No. 207025	American Sumatra Tobacco Co., Bloomfield	8.07	8.23	9.81	5.13	....	5810
6948	Atlantic Packing Co., New Haven, Car No. 23276	American Sumatra Tobacco Co., Bloomfield	8.68	8.23	10.55	7.43	....	6948
5749	Berkshire Chemical Co., Bridgeport	A. & S. Hartman, Hartford	8.62	8.22	10.48	7.90	6.00	5749
6104	Berkshire Chemical Co., Bridgeport	L. B. Haas & Co., Inc., Hartford	8.56	8.22	10.41	5.77	6.00	6104
6603	Berkshire Chemical Co., Bridgeport	Chas. A. Huntington, Windsor	8.48	8.22	10.31	5.61	6.00	6603
6211	Consolidated Rendering Co., Boston, Mass., Car No. 49178	American Sumatra Tobacco Co., Bloomfield	8.58	8.22	10.43	7.58	6.40	6211
6212	Consolidated Rendering Co., Boston, Mass., Car No. 19646	American Sumatra Tobacco Co., Bloomfield	8.36	8.22	10.16	7.93	6.40	6212
6218	Consolidated Rendering Co., Boston, Mass., Car No. 23276	American Sumatra Tobacco Co., Bloomfield	8.41	8.22	10.22	8.00	6.40	6218
6219	Consolidated Rendering Co., Boston, Mass., Car No. 25912	American Sumatra Tobacco Co., Bloomfield	8.73	8.22	10.61	7.59	6.40	6219
7529	Olds & Whipple, Inc., Hartford	John M. Herr, Burnside	8.25	8.23	10.03	6.63	5.00	7529
5769	Car No. 245064	American Sumatra Tobacco Co., Bloomfield	8.20	....	9.97	4.90	....	5769
6332	....	Truman H. Hale, Gildersleeve	8.48	....	10.31	7.69	....	6332

TANKAGE.

This material is meat and bone refuse from various sources. The refuse is steamed and pressed to remove fat and is then dried and ground. Its composition depends upon the proportions of meat and of bone which are present. In general, 5 per cent or less of nitrogen and 15 per cent or more of phosphoric acid indicate considerable admixtures of bone. High grade tankage contains 8 to 10 per cent of nitrogen and 5 to 10 per cent of phosphoric acid.

Garbage tankage is of much less value as a fertilizer and contains usually not over 3.5 per cent of nitrogen and not over 5 per cent of phosphoric acid.

Eight samples of meat and bone tankage were analyzed during the year. Two, and possibly three, of them were essentially bone tankage: the remainder were high in nitrogen and relatively low in phosphoric acid, indicating considerable amounts of meat. All met the guaranties under which they were sold.

Analyses are given in Table X.

GROUND BONE.

Thirty-seven samples of ground bone were analyzed. Twenty-one of them were sampled by the Station agent and the remainder were sampled and submitted by the dealers or purchasers.

Of the official samples only two deficiencies were found, one in nitrogen and one in phosphoric acid.

The average composition of this raw material this year based upon analyses of all samples submitted is 3.12 per cent of nitrogen and 24 per cent of phosphoric acid.

Analyses are given in Table XI.

TABLE X. ANALYSES OF TANKAGE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
6619	Apothecaries Hall Co., Waterbury.......	Sampled at factory...........	3.79	3.29	4.61	23.64	20.00	50.0	50.0	6619
6683	Apothecaries Hall Co., Waterbury.......	Chas. Templeton, Waterbury..	7.96	7.40	9.68	6.21	3.00	51.0	49.0	6683
6634	Connecticut Fat Rendering & Fertilizer Corp., New Haven.................	Sampled at factory...........	3.30	3.29	4.01	22.21	25.00	61.0	39.0	6634
6650	Consolidated Rendering Co., Boston, Mass.	Frank Libner & Son, Norwalk..	5.32	4.92	6.47	17.16	14.00	28.0	72.0	6650
6653	Consolidated Rendering Co., Boston, Mass.	L. T. Frisbie Co., New Haven..	7.43	7.41	9.03	10.22	9.15	20.0	80.0	6653
7179	I. P. Thomas & Son Co., Philadelphia, Pa.	Wm. Snyder, East Wallingford	7.36	7.40	8.95	11.15	....	45.0	55.0	7179
6933	Wilcox Fertilizer Co., Mystic...........	M. E. Thompson, Ellington....	8.89	7.40	10.81	6.48	4.50	58.0	42.00	6933
	Sampled by Purchaser:									
6954	Consolidated Rendering Co., Boston, Mass.	Daigle Bros., Marion.........	7.52	7.41	9.14	10.45	9.15	18.0	82.0	6954

TABLE XI. ANALYSES OF GROUND BONE.

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station:		%	%	%	%	%	%	%	
6610	American Agricultural Chemical Co., New York	Roodner Feed Co., So. Norwalk	2.65	2.47	3.22	25.36	22.88	72.0	28.0	6610
6612	Apothecaries Hall Co., Waterbury	J. A. Glasnapp, West Cheshire	4.00	3.29	4.86	22.72	20.00	55.0	45.00	6612
6884	Apothecaries Hall Co., Waterbury	Sampled at factory	3.02	2.46	3.67	25.80	22.00	60.0	40.0	6884
6809	Armour Fertilizer Works, New York	F. C. Benjamin, Danbury	2.79	2.47	3.39	23.65	22.00	63.0	37.0	6809
6632	Berkshire Chemical Co., Bridgeport	Frank Libner & Son, Norwalk	4.56	2.47	5.54	19.71	20.00	49.0	51.0	6632
7532	E. D. Chittenden Co., Bridgeport	J. E. Stoddard, Abington	3.31	2.47	4.02	22.40	20.00	41.5	58.5	7532
6661	Consolidated Rendering Co., Boston, Mass.	Geo. S. Phelps & Co., Thompsonville	2.09	2.46	2.54	24.47	22.90	52.0	48.0	6661
7398	Consolidated Rendering Co., Boston, Mass.	Pring Bros., Wallingford	2.92	2.46	3.55	27.00	22.90	52.0	48.0	7398
6703	Eastern States Farmers' Exchange, Springfield, Mass.	Stephen Hoyt's Sons, New Canaan	3.12	2.46	3.79	24.57	23.00	53.0	47.0	6703
6654	L. T. Frisbie Co., New Haven	Sampled at factory	2.98	2.46	3.62	23.50	22.90	53.0	47.0	6654
6655	L. T. Frisbie Co., New Haven	Frank S. Platt Co., New Haven	3.97	3.28	4.83	22.87	22.00	40.0	60.0	6655
6902	International Agricultural Corp., Boston, Mass.	Willimantic Grain Co., Willimantic	2.22	2.47	2.70	25.55	22.00	83.0	17.0	6902
6656	Mapes Formula & Peruvian Guano Co., New York	Mapes Branch, Hartford	4.10	3.29	4.98	20.33	20.00	35.0	65.0	6656
6677	Olds & Whipple, Inc., Hartford	Silberman & Kahn, Hartford	2.86	2.50	3.48	22.65	22.00	63.0	37.0	6677

TABLE XI. ANALYSES OF GROUND BONE—*Continued*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen. Total found.	Nitrogen. Total guaranteed.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Found.	Phosphoric Acid. Guaranteed.	Mechanical Analysis. Finer than 1-50 inch.	Mechanical Analysis. Coarser than 1-50 inch.	Station No.
	Sampled by Station		%	%	%	%	%	%	%	
7335	Piedmont Mt. Airy Guano, Baltimore, Md.	Fred H. Rolf, Inc., Guilford	2.66	2.47	3.23	24.15	21.00	42.0	58.0	7335
6658	The Rogers & Hubbard Co., Portland	Cadwell & Jones, Hartford	3.74	3.82	4.55	24.91	24.70	78.0	22.0	6658
6743	The Rogers & Hubbard Co., Portland	Sampled at factory	3.44	3.29	4.18	20.80	20.50	55.0	45.0	6743
7584	M. L. Shoemaker & Co., Philadelphia, Pa.	Olds & Whipple, Inc., Hartford	3.38	3.70	4.11	25.05	21.00	69.0	31.0	7584
6747	I. P. Thomas & Sons Co., Philadelphia, Pa.	F. C. Morse & Son, Guilford	2.75	2.45	3.34	24.10	23.00	61.0	39.0	6747
6847	Wilcox Fertilizer Co., Mystic	M. E. Thompson, Ellington	2.48	2.46	3.02	24.40	22.00	48.0	52.0	6847
	Sampled by Purchaser:									
6625	American Agricultural Chemical Co., New York	J. C. Dufford, Glastonbury	2.55	2.47	3.10	25.56	22.00	47.0	53.0	6625
6174	Apothecaries Hall Co., Waterbury, Car No. 81894	Hatheway & Steane, Inc., Hartford	4.91	3.29	5.97	20.92	20.00	32.0	68.0	6174
6339	Apothecaries Hall Co., Waterbury, Car. No. 160545	Hatheway & Steane, Inc., Hartford	3.96	3.29	4.81	22.97	20.00	57.0	43.0	6339
6368	Apothecaries Hall Co., Waterbury, Car. No. 92564	Hatheway & Steane, Inc., Hartford	4.28	3.29	5.20	21.61	20.00	32.0	68.0	6368
7010	Apothecaries Hall Co., Waterbury, Car No. 150092	Hatheway & Steane, Inc., Hartford	4.13	3.29	5.02	22.10	20.00	43.0	57.0	7010
7142	Apothecaries Hall Co., Waterbury, Car No. N. H. 73843	A. N. Shepard & Son, Hartford	3.94	3.29	4.79	23.35	20.00	58.0	42.0	7142

TABLE XI. ANALYSES OF GROUND BONE—*Concluded*

Station No.	Manufacturer.	Dealer or Purchaser.	Nitrogen.		Ammonia equivalent to total nitrogen.	Phosphoric Acid.		Mechanical Analysis.		Station No.
			Found.	Guaranteed.		Found.	Guaranteed.	Finer than 1-50 inch.	Coarser than 1-50 inch.	
	Sampled by Purchaser:		%	%	%	%	%	%	%	
5811	Armour Fertilizer Works, New York, Car No. S 41390	American Sumatra Tobacco Co., Bloomfield	2.92	2.47	3.55	26.10	22.00	48.0	52.0	5811
5812	Armour Fertilizer Works, New York, Car No. 78584	American Sumatra Tobacco Co., Bloomfield	2.71	2.47	3.29	26.53	22.00	43.0	57.0	5812
5821	Armour Fertilizer Works, New York, Car No. 84878	American Sumatra Tobacco Co., Bloomfield	2.62	2.47	3.19	26.48	22.00	48.0	52.0	5821
5903	Armour Fertilizer Works, New York, Car No. 58278	American Sumatra Tobacco Co., Bloomfield	2.62	2.47	3.19	26.32	22.00	43.0	57.0	5903
5904	Armour Fertilizer Works, New York, Car No. 149319	American Sumatra Tobacco Co., Bloomfield	2.36	2.47	2.87	27.22	22.00	55.5	44.5	5904
7132	Armour Fertilizer Works, New York, Car No. 22050	American Sumatra Tobacco Co., Bloomfield	2.28	2.47	2.77	27.25	22.00	51.5	48.5	7132
5524	Hollingshurst Co., New York, Car No. 254306	American Sumatra Tobacco Co., Bloomfield	2.75	....	3.34	21.07	....	40.0	60.0	5524
5525	Hollingshurst Co., New York, Car No. 48826	American Sumatra Tobacco Co., Bloomfield	2.59	....	3.15	20.51	....	51.0	49.0	5525
7598	The Rogers & Hubbard Co., Portland	The Rogers & Hubbard Co., Portland	3.34	....	4.06	26.30	24.70	....	....	7598
6750	......	Elliott A. Gardner, Meriden	1.01	....	1.23	25.64	....	20.0	80.0	6750
7234	......	Frank L. Davis, Putnam	3.25	....	3.95	22.95	....	53.0	47.0	7234

VI. MIXED FERTILIZERS.

MIXTURES CONTAINING ONLY NITROGEN AND PHOSPHORIC ACID.

Five samples of this group of materials were analyzed.

6882. Ammo Phos. American Cyanamid Co., New York. Sampled by the Station agent from stock of Olds & Whipple, Inc., Hartford, Conn.

7213. Ammo Phos. American Cyanamid Co., New York. Sampled by the Station agent from stock of Olds & Whipple, Inc., Hartford, Conn.

6808. Liberty Lawn Fertilizer. Apothecaries Hall Co., Waterbury. Sampled by the Station agent at factory.

7433. "Swift-Sure" Tobacco Starter 4-10-0. M. L. Shoemaker, Philadelphia, Pa. Sampled by the Station agent from stock of F. T. Blish Hardware Co., South Manchester, Conn.

7426. O & W High Grade Tobacco Starter. Olds & Whipple, Inc., Hartford, Conn. Sampled by the Station agent from stock of Steane, Hartman & Co., Hartford, Conn.

	6882	7213	6808	7433	7426
	%	%	%	%	%
Nitrogen, found	15.60	16.00	4.51	3.46	8.58
guaranteed	16.00	16.00	3.29	3.25	8.23
Ammonia equivalent to nitrogen	18.97	19.45	5.48	3.46	10.43
Phosphoric acid, total	21.80	21.70	13.88	11.73	5.03
available found	21.20	20.82	8.18	10.55	4.33
guaranteed	19.00	19.00	4.00	10.00	3.00

MIXTURES CONTAINING ONLY PHOSPHORIC ACID AND POTASH.

Only one sample in this group was analyzed.

7078. A. A. C. Tobacco Ash Elements. American Agricultural Chemical Co. Sampled by Station agent from stock of Spencer Bros., Suffield.

It contained 5.63 per cent total and 5.35 per cent available phosphoric acid, and 14.32 per cent of potash. It was guaranteed 0-5-15.

MIXTURES CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH.

In Table XII are given analyses of two hundred and forty-three samples of complete fertilizers, all being official samples drawn for inspection purposes by the Station agent.

The A. O. A. C. Committee on Definitions of Terms and Interpretation of Results on Fertilizers urges the practice of including the analysis or grade of fertilizer as a part of the brand name thereof, both by manufacturers in labelling their goods and by control officials in reports and publications. Accordingly, in our analyses the grade is given following the brand name, and for ready comparison, the corresponding items in the analytical results are given in bold face type.

The outstanding facts brought out by the inspection this year may be summarized as follows:

Total number of official samples analyzed		243
Samples considerably deficient in		
one item	69	
two items	8	
three items	1	
total samples deficient		78
Total items of plant food guaranteed (243 x 3)		729
Total items found deficient:		
ammonia	24	
available P_2O_5	30	
potash	34	88
Commercial deficiencies exceeding $1.00 per ton		7

This tabulated statement shows that one-third of the total number of samples analyzed were deficient in one or more of the guaranteed items of plant food; but that less than four per cent were deficient in more than one of such items.

Ammonia, available phosphoric acid and potash being guaranteed in each of the samples analyzed there was a total of seven hundred and twenty-nine guaranties made, of which number eighty-eight were short by considerable amounts; in other words about 12 per cent of the guaranties made were not met and 88 per cent were substantially met or exceeded.

The distribution of deficiencies is about equally divided between ammonia, phosphoric acid and potash. The deficiencies in the most expensive ingredient (ammonia), were fewest in number.

Shortages in money value in excess of $1.00 per ton have been found in only seven samples, which is less than 3 per cent of the total number.

However, guaranties required by law are minimum guaranties in all cases and purchasers are not altogether satisfied when only about two-thirds of the samples examined in an official inspection meet these conditions. With all due allowance for analytical differences which may occur between industrial and control laboratories, it would seem, nevertheless, that a greater number of samples should be found which meet guaranties in all respects.

Concerning Deficient Samples.

The following brands show deficiencies in money value in excess of $1.00 per ton, the approximate amount being arrived at by balancing overruns against shortages and reckoning ammonia at 20 cents, available phosphoric acid at 5½ cents, and potash at 5 cents per pound.

Table XIII. Samples Showing Commercial Deficiencies.

Sta. No.	Brand.	Approximate deficiency in money value per ton.
7057	Eastern States 10-16-14	$4.26
7100	Eastern States 8-6-6	1.83
7339	Essex Top Dresser 7-6-5	2.32
6838	Royster's 5% Truck Guano 5-8-7	1.30[1]
7435	U. S. Guano Co. 4-8-10	7.70[2]
6937	V-C XXXX Fish and Potash	1.68[3]
6932	Wilcox Top Dresser 7-6-5	1.53

[1] Second sample 7480 deficient, but by less than $1.00.
[2] See comment below.
[3] Second sample not deficient.

Sample **7435**, U. S. Guano Co. 4-8-10 shows a large shortage in ammonia and also in potash. The analysis shows that this stock was nearer a 2-8-10 grade than a 4-8-10 and suggested a possible mistake in our sample inasmuch as 2-8-10 goods were in stock at the place of sampling. Another sample could not be secured, but an examination of the inspector's records showed no error; and an examination of the empty sacks at the purchaser's farm showed that the markings were clear and not likely to be confused. The grade 4-8-10 was plainly marked, and in the case of the 2-8-10 goods the grade did not appear at all, but the brand name "Mammoth Potato Grower" was given. We could only conclude that 2-8-10 goods were packed in bags marked 4-8-10 by mistake; but in any event there was a substantial deficiency in potash.

Commercial Deficiencies for a Period of Years.

In a system of inspection where many brands are represented by single analyses the products of the several manufacturers may not be fairly evaluated in any one year. Although it is our purpose to examine at least two samples of any brand showing considerable deficiencies, a second sample is not always obtainable. Comparisons are more informing, therefore, if made upon data covering a period of years. A number of different bases might be chosen for such comparisons, but since it has been our practice for many years to cite brands in which commercial deficiencies amount to one dollar or more per ton, these data have been com-

piled for the 7-year period 1921-1927, and are tabulated in Table XIV. No manufacturer is included unless ten or more samples have been analyzed in the period covered. The compilation shows that of a total of over 1600 samples analyzed less than 10 per cent have fallen short of guaranties to any considerable extent in commercial value. Or, in other words, purchasers have received commercial values represented by the guaranties in over 90 per cent of purchases made.

TABLE XIV. COMMERCIAL DEFICIENCIES FOR THE PERIOD 1921-1927.

Manufacturer.	Total number of samples.	Number equaling or exceeding guaranties in money value.	Per cent for 7 yr. period.	Per cent for 1927.
American Agricultural Chemical Co.	305	293	96	100
Apothecaries Hall Co.	61	61	100	100
Armour Fertilizer Works	73	55	75	100
Atlantic Packing Co.	48	44	92	100
Berkshire Fertilizer Co.	60	60	100	100
Boardman, F. E.	12	12	...[1]	...
Bridges, A. D. & Sons	15	15	100	100
Chittenden, E. D. Co.	45	41	92	100
Clark, E. B., Seed Co.	32	30	94	100
Coe-Mortimer Co.	30	27	...[1]	...
Eastern States Farmers' Exchange	65	54	83	77
Essex Fertilizer Co.	46	45	98	83
Frisbie. L. T. Co.	74	64	87	100
International Agricultural Corp.	59	54	92	100
Lowell Fertilizer Co.	73	65	89	100
Mapes Formula and Peruvian Guano Co.	90	89	99	100
New England Fertilizer Co.	55	52	95	100
Nitrate Agencies	14	11	...	...
Olds & Whipple, Inc.	44	44	100	100
Parmenter & Polsey	25	24	96	100
Piedmont-Mt. Airy Guano Co.	29	20	69	100
Rogers & Hubbard Co., The	97	94	97	100
Royster, F. S. Guano Co.	54	41	76	89
Shoemaker, M. L. & Co.	19	19	100	100
Springfield Rendering Co.	29	27	93	100
Thomas, I. P. & Son	24	24	100[2]	100
United States Guano Co.	16	15	93[2]	75
Virginia-Carolina Chemical Co.	53	49	92	75
Wilcox Fertilizer Co.	56	52	93	83
Worcester Rendering Co.	25	22	88	100
Totals	1628	1503	92	97

[1] No samples in 1927.
[2] For three years.

New England Standard Nine.

The nine fertilizer grades chosen as adequate for all agricultural needs in New England have been represented in the inspection this year as shown in the accompanying summary:

Grade.	No. of Samples.
0-12-6	0
2-12-4	2
3-10-4	2
3-10-6	0
4- 8-4	35
4- 8-6	4
5- 4-5	20
5- 8-7	38
8- 6-6	4
Total	105

In no year since the standard nine was selected has the number of samples taken in official inspection and falling in these respective grades equalled one-half of the total number of samples drawn. We are unable to say what proportion of the total tonnage is represented in these nine grades.

Quality of Insoluble Organic Nitrogen.

Examination of the insoluble organic nitrogen in mixed fertilizers this year has shown no conclusive evidence of inferior ammoniates.

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Samplir
	Sampled by Station: **American Agricultural Chemical Co., New York.**		
7210	A. A. C. Tobacco Starter..................	3-7-16	Ellington......
6939	Acme Fertilizer..........................	1-9-4	Bloomfield....
6970	Aroostook Potato Manure..................	5-8-7	Bloomfield.....
6940	Complete General Fertilizer...............	3-8-4	Bloomfield.....
7084	Double A Tobacco Fertilizer...............	5-4-5	Gaylordsville..
6968	Gladiator Fertilizer.......................	4-8-7	North Haven..
6765	Grass & Lawn Top Dressing...............	6-6-4	Middletown...
6919	Grass & Lawn Top Dressing...............	6-6-4	Milford.......
7477	Hi-Grade Tobacco Manure................	7-4-7	Poquonock....
6963	Monarch Fertilizer.......................	4-8-4	New Britain...
6936	Old Hickory Fertilizer....................	2-8-10	North Haven..
7533	Patapsco 5-8-7...........................	5-8-7	Silver Lane....
6768	Bowker's All Round Fertilizer.............	3-8-4	New Milford...
6965	Bowker's Market Garden Fertilizer..........	4-8-4	Willimantic....
6767	Bowker's Potato & Vegetable Phosphate.....	2-9-3	New Milford...
6769	Bowker's Stockbridge Early Crop Manure....	5-8-7	New Canaan...
6926	Bowker's Stockbridge Early Crop Manure....	5-8-7	Milldale.......
6969	Bowker's Stockbridge Hill & Drill Fertilizer..	4-8-7	Milldale.......
6962	Bowker's Stockbridge Tobacco Manure......	5-4-5	New Milford...
7407	Bowker's Sure Crop Fertilizer.............	1-9-4	Higganum.....
6993	Bradley's Blood, Bone and Potash..........	5-8-7	Suffield........
7083	Bradley's Complete Manure for Potatoes and Vegetables.........................	4-8-7	Bethel........
6992	Bradley's Complete Tobacco Manure........	5-4-5	Suffield........
6764	Bradley's Eclipse Fertilizer................	1-9-4	Meriden.......
6967	Bradley's Northland Potato Grower.........	4-8-4	Glastonbury...
7076	Bradley's Potato Fertilizer................	2-9-3	Colchester.....
6762	Bradley's Potato Manure.................	3-8-4	Suffield........
6918	Bradley's Potato Manure.................	3-8-4	Meriden.......
6761	Bradley's XL Superphosphate of Lime.......	3-10-4	Windsor Locks.
6991	National Aroostook Special Fertilizer........	5-8-7	West Cheshire.
7081	National Complete Tobacco Fertilizer.......	5-4-5	Simsbury......
6995	National Market Garden Fertilizer..........	3-8-4	Middletown...
6994	National Pine Tree State Potato Fertilizer...	4-8-4	Middletown...
7080	National Premier Potato Manure...........	4-8-7	Simsbury......
6998	Sanderson's Atlantic Coast Mixture.........	3-10-4	West Cheshire.
7077	Sanderson's Complete Tobacco Grower......	5-4-5	Glastonbury...
6996	Sanderson's Corn Superphosphate...........	2-9-3	So. Coventry...
6997	Sanderson's Formula A....................	4-8-4	So. Coventry..
7402	Sanderson's Formula A....................	4-8-4	Woodstock....
6999	Sanderson's Formula B....................	4-8-7	West Cheshire.
7408	Sanderson's Potato Manure................	3-8-4	West Haven...
7074	Sanderson's 5-8-7 Fertilizer................	5-8-7	Milford.......

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH.

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
1.60	0.14	0.79	2.61	3.17	0.27	7.35	7.08	1.28	16.17	7210
0.44	0.38	0.26	1.20	1.46	0.60	9.24	8.64	4.02	4.02	6939
3.08	0.52	0.52	4.12	5.01	0.35	8.20	7.85	6.96	6.96	6970
1.60	0.48	0.48	2.58	3.14	0.45	8.46	8.01	4.00	4.00	6940
1.13	0.36	2.56	4.12	5.01	0.20	4.65	4.45	0.39	4.98	7084
2.32	0.42	0.50	3.36	4.09	0.17	8.14	7.97	7.05	7.05	6968
3.92	0.13	0.54	4.94	6.01	0.15	6.47	6.32	3.75	3.75	6765
3.06	0.22	0.58	4.78	5.81	0.38	6.80	6.42	3.99	3.99	6919
0.77	0.48	3.91	5.61	6.82	0.20	4.63	4.43	0.69	7.23	7477
1.93	0.57	0.53	3.25	3.95	0.55	8.58	8.03	3.90	3.90	6963
1.00	0.34	0.32	1.70	2.07	0.28	8.46	8.18	10.07	10.07	6936
2.78	0.73	0.51	4.02	4.89	0.53	8.24	7.71	6.39	6.39	7533
1.58	0.27	0.46	2.52	3.06	0.26	8.10	7.84	4.05	4.05	6768
2.10	0.47	0.57	3.26	3.96	0.37	8.41	8.04	4.13	4.13	6965
0.94	0.40	0.38	1.76	2.14	0.58	9.78	9.20	2.90	2.90	6767
3.08	0.36	0.52	4.08	4.96	0.37	8.23	7.86	6.66	6.66	6769
3.09	0.62	0.50	4.28	5.20	0.30	8.50	8.20	6.72	6.72	6926
2.32	0.43	0.54	3.29	4.00	0.20	8.43	8.23	7.04	7.04	6969
0.79	0.49	2.38	4.18	5.08	0.18	4.13	3.95	0.13	5.44	6962
0.28	0.43	0.27	1.04	1.26	0.54	9.50	8.96	4.02	4.02	7407
3.11	0.48	0.52	4.11	5.00	0.48	8.88	8.40	6.75	6.75	6993
2.30	0.52	0.56	3.38	4.11	0.30	8.33	8.03	7.08	7.08	7083
0.83	0.56	2.46	4.14	5.03	0.20	3.85	3.65	0.39	4.96	6992
0.19	0.43	0.24	0.94	1.14	0.45	9.06	8.61	3.92	3.92	6764
1.80	0.68	0.53	3.31	4.02	0.65	8.73	8.08	3.68	3.68	6967
1.00	0.47	0.38	1.85	2.25	0.55	9.90	9.35	3.47	3.47	7076
1.55	0.48	0.45	2.48	3.02	0.40	8.45	8.05	3.68	3.68	6762
1.62	0.48	0.47	2.57	3.12	0.52	8.45	7.93	3.88	3.88	6918
1.40	0.52	0.39	2.45	2.98	0.93	11.10	10.17	3.95	3.95	6761
3.00	0.47	0.49	4.02	4.89	0.13	8.39	8.26	7.12	7.12	6991
0.67	0.22	2.88	4.22	5.13	0.15	4.73	4.58	0.61	5.76	7081
1.58	0.44	0.45	2.47	3.00	0.27	8.00	7.73	3.90	3.90	6995
2.29	0.48	0.55	3.32	4.04	0.28	8.25	7.97	3.90	3.90	6994
2.34	0.55	0.52	3.41	4.14	0.25	8.33	8.08	6.85	6.85	7080
1.59	0.45	0.43	2.73	3.32	0.88	10.29	9.41	4.26	4.26	6998
0.57	0.18	2.76	4.00	4.86	0.23	4.33	4.10	0.63	5.03	7077
1.12	0.40	0.33	1.85	2.25	0.24	9.43	9.19	3.59	3.59	6996
2.34	0.43	0.57	3.34	4.06	0.43	8.25	7.82	4.19	4.19	6997
1.63	0.73	0.49	3.17	3.85	0.68	8.95	8.27	3.77	3.77	7402
1.25	0.11	1.30	3.48	4.23	0.26	8.00	7.74	0.70	6.86	6999
1.52	0.44	0.51	2.55	3.10	0.63	8.83	8.20	3.85	3.85	7408
3.00	0.44	0.55	3.99	4.85	0.33	8.23	7.90	6.72	6.72	7074

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampl
	Sampled by Station: **American Agricultural Chemical Co., New York**—Continued.		
7161	Sanderson's 5-8-7. Fertilizer	5-8-7	Woodstock...
7162	Sanderson's 5-8-7. Fertilizer	5-8-7	Woosdtock...
7206	Sanderson's 5-10-5 Fertilizer	5-10-5	Woodstock...
7207	Sanderson's 3-12-3 Fertilizer	3-12-3	Woodstock...
	Apothecaries Hall Co., Waterbury.		
6759	Liberty Corn and All Crops 2-8-2	2-8-2	Cheshire.....
6770	Liberty Corn Fruit and All Crops 2-12-4	2-12-4	Greenwich....
6766	Liberty Fish Bone and Potash 3-8-3	3-8-3	Waterbury...
6990	Liberty High Grade Market Gardners Special 5-8-7	5-8-7	Cheshire.....
7055	Liberty Home Vegetable Garden Fertilizer	4-2-5	Waterbury...
7001	Liberty Onion Special (Potash as Sulphate) 4-8-7	4-8-7	East Windsor.
7000	Liberty Potato and General Crops 4-8-10	4-8-10	East Windsor.
6760	Liberty Potato and Market Gardners Special 4-8-4	4-8-4	Cheshire.....
6883	Liberty Potato and Vegetable 2-8-10	2-8-10	East Windsor.
7158	Liberty Tobacco Special 5-4-5	5-4-5	East Windsor.
7062	Liberty Top Dresser for Grass and Grain 10-3½-8	10-3½-8	New London..
7499	Liberty Top Dresser for Grass and Grain 10-3½-8	10-3½-8	East Windsor.
	Armour Fertilizer Works, New York.		
6925	Armour's Big Crop 4-8-4	4-8-4	Meriden......
6810	Armour's Big Crop 5-8-7	5-8-7	Danbury.....
6879	Armour's Big Crop 8-6-6	8-6-6	Madison.....
6824	Armour's Big Crop Fertilizer 3-8-4	3-8-4	Thompsonville
6886	Armour's Big Crop Fertilizer 4-6-10	4-6-10	Seymour.....
6811	Armour's Big Crop Fertilizer 4-8-4	4-8-4	Danbury.....
7159	Armour's Big Crop Fertilizer 4-16-4	4-16-4	Hampton.....
6823	Armour's Big Crop Tobacco Special 5-4-5	5-4-5	Thompsonville
7400	Armour's Corn Grower	2-8-2	Wethersfield..
	Atlantic Packing Co., New Haven		
6887	Atlantic Grain Fertilizer 2-10-2	2-10-2	Sampled at fac
7204	Atlantic 5-4-16	5-4-16	Glastonbury..
7471	Atlantic Grain Fertilizer 2-10-2	2-10-2	East Hartford.
7203	Atlantic Special Vegetable 4-8-4	4-8-4	Glastonbury..
7205	Atlantic Tobacco Manure 5-8-6	5-8-6	East Hartford.

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
3.05	0.69	0.41	4.28	5.20	0.30	8.30	8.00	7.07	7.07	7161
3.37	0.47	0.43	4.27	5.19	0.28	8.85	8.57	6.67	6.67	7162
3.09	0.25	0.49	4.12	5.01	0.43	10.06	9.63	5.31	5.31	7206
1.79	0.37	0.44	2.79	3.39	0.83	11.86	11.03	3.10	3.10	7207
0.98	0.00	0.87	1.94	2.36	0.78	9.05	8.27	3.33	3.33	6759
1.20	0.47	0.14	1.92	2.33	1.24	12.88	11.64	4.22	4.22	6770
1.03	0.00	0.74	2.78	3.38	0.60	8.58	7.98	3.08	3.08	6766
2.78	0.35	0.14	4.07	4.95	0.60	9.08	8.48	7.60	7.60	6990
0.08	0.52	3.05	3.88	4.72	4.58	11.35	6.77	6.35	6.35	7055
0.10	0.51	1.68	3.59	4.36	2.14	10.06	7.92	0.89	7.22	7001
0.84	0.34	0.11	3.71	4.51	0.68	9.20	8.52	9.89	9.89	7000
2.12	0.36	0.76	3.36	4.09	0.55	9.00	8.45	4.20	4.20	6760
0.80	0.27	0.12	2.11	2.57	0.05	8.15	8.10	11.24	11.24	6883
1.70	0.00	2.63	4.42	5.37	0.20	6.28	6.08	0.57	5.92	7158
6.54	0.31	0.21	7.88	9.58	0.30	4.50	4.20	7.64	7.64	7062
6.60	0.31	1.08	7.99	9.71	0.10	4.65	4.55	9.72	9.72	7499
2.11	0.28	0.25	3.29	4.00	0.27	8.05	7.78	3.90	3.90	6925
3.00	0.23	0.10	4.09	4.97	0.28	8.63	8.35	6.84	6.84	6810
4.75	0.20	0.10	6.55	7.96	0.05	7.03	6.98	6.08	6.08	6879
1.86	0.24	0.21	2.45	2.98	0.24	8.41	8.17	4.31	4.31	6824
2.41	0.31	0.09	3.32	4.04	0.15	6.47	6.32	9.17	9.17	6886
2.02	0.17	0.22	3.03	3.68	0.25	8.48	8.23	4.48	4.48	6811
2.39	0.31	0.09	3.50	4.26	0.33	16.30	15.97	3.32	4.01	7159
0.14	0.13	2.79	3.89	4.73	0.58	5.78	5.20	0.56	5.02	6823
0.94	0.10	0.21	1.54	1.87	0.45	8.65	8.20	2.11	2.11	7400
1.02	0.21	0.36	1.72	2.09	0.14	10.09	9.95	1.74	2.07	6887
1.00	0.37	1.43	4.20	5.11	2.95	9.65	6.70	0.66	17.10	7204
1.06	0.23	0.32	1.64	1.99	0.38	10.80	10.42	2.03	2.03	7471
1.28	0.55	0.79	3.26	3.96	0.68	8.94	8.26	3.90	3.90	7203
1.30	0.56	0.81	4.11	5.00	0.65	9.05	8.40	0.58	5.98	7205

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station:		
	E. J. Bantle, Glastonbury		
6880	Bantle's Wrapper Brand..................	7-4-7	Sampled at fact
	F. A. Bartlett Tree Expert Co., Stamford.		
6877	Bartlett's Green Tree Food.................	6-8-4	Sampled at fact
	Berkshire Chemical Co., Bridgeport.		
6814	Berkshire Complete Fertilizer...............	3-8-3	Ridgefield.....
6927	Berkshire Complete Tobacco...............	5-4-5	Windsorville...
6928	Berkshire Economical Grass Fertilizer.......	10-3-8	Sampled at fact
6813	Berkshire Grass Special....................	7-6-5	Ridgefield.....
6807	Berkshire Long Island Special..............	5-8-7	Guilford......
6806	Berkshire Market Garden Fertilizer.........	4-8-4	Guilford.......
6805	Berkshire Potato and Vegetable Phosphate...	2-9-3	Norwalk......
7209	Berkshire Starter 10% Potash..............	5-8-10	East Granby...
7212	Berkshire Tobacco Special..................	7-4-7	Suffield........
	A. D. Bridges Sons Co., Hazardville.		
7419	A. D. Bridges Sons Special Tobacco Fertilizer.	5-4-5	Somers........
7061	Corn, Onion, Potato and General Purpose....	4-8-4	Sampled at fact
	E. D. Chittenden Co., Bridgeport.		
7216	Chittenden's Complete Grain...............	2-9-3	Bloomfield.....
7217	Chittenden's High Grade Potato 7% Potash..	5-8-7	Abington......
7202	Chittenden's Potato Special 4% Potash......	4-8-4	Bloomfield.....
7220	Chittenden's Tobacco Special...............	5-4-5	Broad Brook...
7225	Chittenden's Tobacco Starter...............	4-6-10	Wapping......
7218	Chittenden's Vegetable and Onion Grower...	3-8-4	Tolland.......
	E. B. Clark Seed Co., Milford.		
6816	Special Mixture General Use...............	4-8-4	Sampled at fact
7063	Special Mixture with 6% Potash............	4-8-6	Branford......
7064	Superphosphate...........................	5-8-7	Branford......
7053	Tip Top Brand............................	5-10-5	Sampled at fact
	C. A. Cowles, Plantsville.		
7054	C. A. Cowles 4-8-4 Fertilizer...............	4-8-4	Sampled at fact
	C & R. Sales Corp., Worcester, Mass.		
7208	C. & R. Lawn and Shrub.................	6-5-5	Norwich.......
	Davey Tree Expert Co., Kent, Ohio.		
7082	Davey Tree Food........................	7-7.3-3	Sound Beach...

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
1.22	0.49	3.07	6.20	7.54	0.46	5.68	5.22	0.66	7.84	6880
3.80	0.28	0.92	5.02	6.10	3.14	11.12	7.98	3.62	3.62	6877
2.10	0.21	0.56	2.95	3.59	0.55	9.30	8.75	3.37	3.37	6814
0.14	0.20	2.93	4.53	5.51	0.50	6.05	5.55	0.98	6.40	6927
4.54	0.39	1.08	8.07	9.81	1.98	9.30	7.32	8.73	8.73	6928
2.54	0.35	1.38	5.78	7.03	0.23	7.80	7.57	5.10	5.10	6813
2.91	0.31	1.24	4.50	5.47	0.25	8.98	8.73	7.32	7.32	6807
2.68	0.27	0.63	3.68	4.47	0.38	8.80	8.42	4.36	4.36	6806
1.41	0.00	0.46	2.02	2.46	0.70	10.88	10.18	3.37	3.37	6805
2.74	0.24	1.36	4.36	5.30	0.85	8.78	7.93	2.22	10.67	7209
0.91	0.19	3.87	5.88	7.15	0.13	4.78	4.65	0.97	8.03	7212
1.06	0.05	3.11	4.34	5.28	0.38	5.23	4.85	0.35	5.78	7419
1.52	0.19	0.92	3.46	4.21	0.68	9.38	8.70	4.23	4.23	7061
1.50	0.19	0.33	2.22	2.70	0.47	9.28	8.81	3.68	3.68	7216
3.44	0.28	0.34	4.06	4.94	0.55	8.60	8.05	7.00	7.00	7217
2.86	0.13	0.36	3.35	4.07	0.30	8.45	8.15	4.43	4.43	7202
2.50	0.26	1.36	4.28	5.20	0.13	4.93	4.80	1.28	5.78	7220
3.07	0.09	0.40	3.56	4.33	0.23	6.45	6.22	2.47	9.29	7225
2.05	0.18	0.32	2.58	3.14	0.48	8.80	8.32	3.82	3.82	7218
2.02	0.05	1.04	3.32	4.04	2.18	9.75	7.57	3.40	4.15	6816
2.32	0.30	0.78	3.40	4.13	0.48	9.03	8.55	6.25	6.25	7063
3.00	0.41	0.90	4.31	5.24	0.33	8.48	8.15	7.07	7.07	7064
3.44	0.14	0.46	4.08	4.96	0.40	10.48	10.08	5.06	5.06	7053
2.16	0.51	0.57	3.36	4.09	0.38	8.90	8.52	4.12	4.12	7054
0.98	1.17	2.94	5.27	6.41	1.18	7.68	6.50	6.12	6.12	7208
3.44	0.45	2.03	5.92	7.20	1.58	9.90	8.32	3.40	3.40	7082

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station: **Eastern States Farmers' Exchange, Springfield, Mass.**		
7059	Eastern States High Analysis Fertilizer 8-16-20	8-16-20	North Haven. .
7057	Eastern States High Analysis Fertilizer 10-16-14..............................	10-16-14	North Haven. .
7099	Eastern States No-Filler 3-12-3.............	3-12-3	Granby.......
7060	Eastern States No-Filler 4-8-10.............	4-8-10	North Haven. .
7056	Eastern States No-Filler 5-8-7..............	5-8-7	North Haven. .
7058	Eastern States No-Filler Fertilizer 5-10-5.....	5-10-5	North Haven. .
7100	Eastern States No-Filler Fertilizer 8-6-6......	8-6-6	Unionville.....
7338	Open Formula A Tobacco Fertilizer.........	6.5-4.25-5.50	Feeding Hills. .
7420	Open Formula A Tobacco Fertilizer..........	6.5-4.25-5.50	Thompsonville
	Essex Fertilizer Co., Boston, Mass.		
7336	Essex A 1 Superphosphate 2-10-2...........	2-10-2	Rockville.....
7215	Essex Complete Manure 5-8-7..............	5-8-7	Wallingford...
7095	Essex Fish Fertilizer, For All Crops 3-8-4....	3-8-4	Wallingford...
7094	Essex Market Garden 4-8-4................	4-8-4	Wallingford....
7224	Essex Tobacco Grower 5-4-5................	5-4-5	Wapping......
7339	Essex Top Dressing 7-6-5..................	7-6-5	West Stafford.
	L. T. Frisbie Co., New Haven.		
7090	Frisbie's 5-8-7...........................	5-8-7	Clintonville...
7474	Frisbie's 5-8-7...........................	5-8-7	Norwich......
7092	Frisbie's Corn and Grain Fertilizer 2-10-2....	2-10-2	Danbury.....
7156	Frisbie's Market Garden 4-8-7..............	4-8-7	Buckland.....
7096	Frisbie's Special 3-8-4....................	3-8-4	New Haven...
7091	Frisbie's Special Vegetable and Potato Grower.	4-8-4	Danbury.....
7223	Frisbie's Tobacco Grower 5-4-5............	5-4-5	Burnside.....
7423	Frisbie's Tobacco Manure..................	5-8-6	Burnside......
7097	Frisbie's Top Dresser 7-6-5................	7-6-5	Orange.......
	International Agricultural Corp. Boston, Mass.		
7330	I. A. C. Crop Grower......................	5-8-7	Willimantic...
7424	I. A. C. High Grade Manure 4-8-10.........	4-8-10	Rockville.....
7331	I. A. C. Ideal............................	4-8-4	Willimantic...
7427	I. A. C. Tobacco Producer 5-4-5............	5-4-5	Suffield.......
7425	I. A. C. Connecticut Valley Special..........	7-4-7	Rockville.....
7214	Special 4-8-6............................	4-8-6	Willimantic...
	Lowell Fertilizer Co., Boston, Mass.		
7260	Lowell Animal Brand, A High Grade Manure 3-8-4................................	3-8-4	Southington. .

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
3.26	0.13	1.21	6.12	7.44	0.95	16.45	15.50	22.56	22.56	7059
4.77	0.44	1.33	7.89	9.59	1.03	15.42	14.39	13.15	13.15	7057
1.84	0.32	0.39	2.65	3.22	1.08	13.05	11.97	3.83	3.83	7099
1.92	0.70	0.26	3.29	4.00	0.51	8.45	7.94	9.24	9.24	7060
2.39	0.37	0.82	4.04	4.91	0.25	8.68	8.43	6.59	6.59	7056
2.22	0.38	0.86	4.00	4.86	0.63	10.93	10.30	4.49	4.49	7058
1.88	0.86	0.80	6.02	7.32	0.50	7.00	6.50	6.34	6.34	7100
0.17	0.32	3.85	5.29	6.43	0.28	6.60	6.32	0.41	4.11	7338
0.12	0.08	3.99	5.39	6.55	0.23	5.65	5.42	1.02	6.54	7420
0.68	0.56	0.54	1.82	2.21	1.15	11.15	10.00	1.91	1.91	7336
2.69	0.45	0.66	4.08	4.96	0.55	8.58	8.03	6.55	6.55	7215
1.42	0.49	0.70	2.61	3.17	0.48	8.70	8.22	4.05	4.05	7095
2.08	0.50	0.91	3.64	4.43	0.68	8.90	8.22	4.05	4.05	7094
0.83	0.38	2.07	4.13	5.02	0.35	5.38	5.03	0.74	6.05	7224
4.69	0.31	0.13	5.20	6.32	0.48	6.81	6.33	5.04	5.04	7339
2.24	0.63	0.79	4.20	5.11	1.08	9.83	8.75	6.92	6.92	7090
2.17	0.85	0.77	4.27	5.19	0.95	9.43	8.48	7.10	7.10	7474
0.97	0.33	0.53	1.86	2.26	1.15	11.15	10.00	2.02	2.02	7092
1.20	0.62	0.76	3.31	4.02	0.55	8.80	8.25	6.55	6.55	7156
1.13	0.43	0.69	2.61	3.17	1.03	9.20	8.17	4.00	4.00	7096
1.44	0.57	0.58	3.36	4.09	1.10	9.53	8.43	4.09	4.09	7091
0.04	0.28	2.14	4.10	4.98	0.50	5.35	4.85	0.86	5.82	7223
1.34	0.80	0.68	4.00	4.86	0.75	9.55	8.80	0.66	6.03	7423
2.57	0.94	0.89	6.14	7.47	1.23	7.80	6.57	4.76	4.76	7097
2.38	0.30	1.09	4.10	4.98	0.18	8.33	8.15	7.02	7.02	7330
1.90	0.13	0.80	3.25	3.95	2.53	10.65	8.12	10.73	10.73	7424
1.73	0.20	0.84	3.31	4.02	0.10	8.10	8.00	4.12	4.12	7331
2.10	0.37	2.17	4.66	5.67	0.06	3.33	3.27	1.37	6.82	7427
2.04	1.49	2.21	5.90	7.17	0.09	3.98	3.89	0.58	7.18	7425
1.74	0.09	0.71	3.18	3.87	0.13	8.28	8.15	5.85	5.85	7214
1.33	0.50	0.62	2.45	2.98	0.92	8.51	7.59	3.82	3.82	7260

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli
	Sampled by Station:		
	Lowell Fertilizer Co., Boston, Mass.		
7261	Lowell Bone Fertilizer 2-10-2	2-10-2	Southbury
7258	Lowell Corn and Vegetable 4-8-4	4-8-4	Southington
7416	Lowell Market Garden Manure 5-8-7	5-8-7	Somersville
7262	Lowell Market Garden Manure 5-8-7	5-8-7	Milford
7259	Lowell Potato Phosphate 4-8-7	4-8-7	Southington
7267	Lowell Tobacco 5-4-5	5-4-5	Ellington
7266	Lowell Top Dressing 7-6-5	7-6-5	Ellington
6681	Lowell 3-12-3	3-12-3	Cheshire
6680	Lowell 5-10-5	5-10-5	Cheshire
7417	Lowell 5-10-5	5-10-5	Orange
6682	Lowell 8-6-6	8-6-6	Cheshire
	Mapes Formula and Peruvian Guano Co., New York.		
6984	Mapes Conn. Valley Special	6-4-7	East Granby
6897	Mapes Corn Manure	3-8-3	Hartford
6985	Mapes General Tobacco Manure	5-4-5	East Granby
6898	Mapes General Truck Manure	5-6-5	Hartford
6976	Mapes General Use Manure	3-6-4	Windsor Locks
7263	Mapes Onion Manure	4-6-4	Hartford
6896	Mapes Potato Manure	4-7-5	Hartford
7257	Mapes Special Trucker	5-8-7	Hartford
7264	Mapes Tobacco Ash Constituents	1-4-15	East Granby
7274	Mapes Tobacco Ash and Starter	4-6-15	East Granby
7405	Mapes Tobacco Manure, Wrapper Brand	7.5-2-10.5	East Granby
6977	Mapes Tobacco Starter Improved	5-6-1	Windsor Locks
7256	Mapes Top Dresser	10-4-2	Hartford
	A. G. Markham & Co., Springfield, Mass.		
7281	4-8-4	4-8-4	Stafford Spring
7282	5-8-7	5-8-7	Stafford Spring
	New England Fertilizer Co., Boston, Mass.		
7271	New England Complete Manure 4-6-10	4-6-10	Meriden
6978	New England Corn Phosphate 2-10-2	2-10-2	Rockville
6980	New England Market Garden Manure 5-8-7	5-8-7	Meriden
6979	New England Potato and Vegetable Manure 4-8-4	4-8-4	Chester
6986	New England Superphosphate, A High Grade Fertilizer for All Crops 3-8-4	3-8-4	Unionville
7404	New England Tobacco Manure 5-4-5	5-4-5	Unionville
7273	New England Top Dressing 7-6-5	7-6-5	Chester

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.					Phosphoric Acid.			Potash.		
In ammonia.	Organic water-soluble.	Organic water insoluble.	Total.	Ammonia equivalent to total nitrogen.	Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	Station No.
%	%	%	%	%	%	%	%	%	%	
0.61	0.47	0.60	1.73	2.10	1.08	10.06	8.98	2.35	2.35	7261
2.02	0.36	0.73	3.31	4.02	0.80	8.38	7.58	4.11	4.11	7258
2.92	0.57	0.56	4.30	5.23	0.35	8.58	8.23	6.83	6.83	7416
2.06	0.51	0.77	4.34	5.28	0.70	8.83	8.13	4.90	6.82	7262
2.02	0.35	0.71	3.33	4.05	0.91	8.35	7.44	7.42	7.42	7259
0.86	0.29	2.17	4.26	5.18	0.20	5.10	4.90	1.06	5.74	7267
2.98	0.83	0.75	5.88	7.15	0.80	7.08	6.28	3.35	4.99	7266
1.47	0.57	0.47	2.63	3.20	0.74	13.07	12.33	2.50	3.20	6681
2.71	0.77	0.71	4.31	5.24	0.75	11.02	10.27	5.14	5.35	6680
2.62	1.02	0.68	4.32	5.25	0.88	11.05	10.17	5.13	5.13	7417
0.77	1.25	1.06	6.71	8.16	0.61	6.95	6.34	6.27	6.27	6682
0.14	0.42	2.58	5.00	6.08	1.13	6.55	5.42	0.58	8.07	6984
1.38	0.13	0.48	2.71	3.29	1.60	11.18	9.58	2.41	3.22	6897
0.10	0.42	2.45	4.68	5.69	1.38	6.03	4.65	0.39	5.95	6985
2.93	0.17	0.34	4.17	5.07	0.93	9.35	8.42	4.72	5.67	6898
1.23	0.03	0.32	2.64	3.21	0.83	8.55	7.72	3.02	4.54	6976
1.96	0.03	0.33	3.35	4.07	0.70	7.75	7.05	0.23	4.49	7263
2.08	0.06	0.36	3.32	4.04	1.25	10.68	9.43	4.95	4.95	6896
2.97	0.19	0.39	4.17	5.07	1.08	11.93	10.85	7.21	7.21	7257
0.08	0.18	0.65	1.40	1.70	1.85	6.93	5.08	0.70	15.35	7264
0.02	0.33	0.55	3.62	4.40	1.73	7.88	6.15	0.82	17.04	7274
0.15	0.00	4.02	6.82	8.29	1.53	5.63	4.10	0.88	11.76	7405
1.88	0.24	1.13	4.76	5.79	2.08	8.73	6.65	0.27	1.71	6977
2.51	0.17	0.40	8.27	10.05	0.45	7.45	7.00	0.25	2.66	7256
1.50	0.78	0.71	3.36	4.09	0.83	8.55	7.72	4.10	4.10	7281
2.37	0.67	0.76	4.24	5.15	0.90	8.92	8.02	7.02	7.02	7282
1.98	0.47	0.75	3.36	4.09	0.69	6.60	5.91	9.97	9.97	7271
0.63	0.49	0.49	1.65	2.01	1.07	10.38	9.31	1.98	1.98	6978
2.81	0.53	0.67	4.16	5.06	0.70	8.38	7.68	7.21	7.21	6980
2.00	0.46	0.70	3.42	4.16	0.75	8.65	7.90	4.02	4.02	6979
1.41	0.48	0.75	2.71	3.29	1.05	8.89	7.84	4.02	4.02	6986
0.88	0.28	2.20	4.24	5.15	0.45	5.33	4.88	1.39	6.07	7404
5.14	0.31	0.09	5.54	6.74	0.58	7.33	6.75	5.16	5.16	7273

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Samplin
	Sampled by Station: **Old Deerfield Fertilizer Co., So. Deerfield, Mass.**		
7277	Old Deerfield 5-8-7	5-8-7	Suffield
7276	Old Deerfield 7-4-7	7-4-7	Suffield
	Olds & Whipple, Inc., Hartford		
6975	O & W Complete Market Garden Fertilizer	4-8-4	So. Manchester
7280	O & W Complete Tobacco Fertilizer	5-4-5	E. Windsor Hill
6982	O & W Grain and General Crop Fertilizer	2-9-3	Sampled at factc
6899	O & W Grass Fertilizer	6-6-4	So. Manchester
6981	O & W High Grade Vegetable and Potato Fertilizer	5-8-7	Wethersfield
6983	O & W High Grade Starter and Potash Compound	5-4-15	Burnside
6964	O & W Tobacco Fertilizer Blue Label Brand	6-3-6	Manchester
	Parmenter & Polsey, Boston, Mass.		
7403	P & P A. A. Brand 5-8-7	5-8-7	Plainville
7534	P & P Corn and Vegetable 4-8-4	4-8-4	Plainville
7278	P & P Maine Potato Fertilizer 4-6-10	4-6-10	Wallingford
7406	P & P Plymouth Rock Brand for All Crops 3-8-4	3-8-4	Hartford
	Piedmont Mt. Airy Guano Co., Baltimore, Md.		
7275	Piedmont 4-6-10 Fertilizer	4-6-10	Seymour
6972	Piedmont 5-8-7 Fertilizer	5-8-7	Seymour
6971	Piedmont 8-6-6 Fertilizer	8-6-6	Seymour
7334	Piedmont Plow Brand	2-8-2	Guilford
7279	Piedmont Unexcelled Guano	4-8-4	Plantsville
	Frank S. Platt Co., New Haven.		
6961	Platco Special	5-8-7	Sampled at fact(
	Rackliffe Bros. Co., New Britain.		
7175	4-8-4 Rackliffe Brand	4-8-4	Sampled at fact(
7176	5-8-7 Rackliffe Brand	5-8-7	Sampled at fact(
	The Rogers & Hubbard Co., Portland.		
7272	4-8-4	4-8-4	Willimantic
7439	5-8-7	5-8-7	Norwich
6836	Garden Fertilizer	2-8-4	Hartford
6820	Hubbard's "Bone Base" Fertilizer for Seeding Down	3-5-6	Sampled at fact(
6818	Hubbard's "Bone Base" *Oats and Top* Dressing	10-3-8	Higganum

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
1.30	1.24	0.62	3.95	4.80	0.98	9.43	8.45	6.96	6.96	7277
0.41	1.49	3.39	6.18	7.51	0.15	5.28	5.13	0.97	7.74	7276
2.02	0.18	0.69	3.52	4.28	0.40	8.83	8.43	4.20	4.20	6975
1.08	0.08	3.09	4.28	5.20	0.38	5.03	4.65	0.31	5.54	7280
0.88	0.01	0.60	1.93	2.35	0.60	10.18	9.58	3.41	3.41	6982
2.46	0.19	0.11	5.16	6.27	0.50	6.90	6.40	4.86	4.86	6899
2.20	0.20	1.08	4.44	5.40	0.68	8.90	8.22	0.66	7.08	6981
0.86	0.26	2.01	4.22	5.13	0.45	5.40	4.95	1.02	16.12	6983
1.18	0.37	3.42	5.14	6.25	0.23	3.95	3.72	0.40	6.90	6964
2.66	0.51	0.75	4.08	4.96	0.40	8.65	8.25	6.57	6.57	7403
2.02	0.31	0.86	3.19	3.88	0.75	8.06	7.31	4.00	4.00	7534
2.09	0.39	0.69	3.50	4.26	0.57	6.53	5.96	9.83	9.83	7278
1.30	0.56	0.71	2.67	3.25	1.10	8.95	7.85	4.03	4.03	7406
2.50	0.20	0.54	3.24	3.94	1.00	7.45	6.45	9.67	9.67	7275
2.91	0.51	0.46	3.97	4.83	1.25	9.33	8.08	6.60	6.60	6972
5.13	0.44	0.36	6.15	7.48	0.85	7.70	6.85	6.17	6.17	6971
0.82	0.39	0.43	1.68	2.04	1.83	10.05	8.22	2.79	2.79	7334
2.22	0.33	0.58	3.19	3.88	1.14	9.03	7.89	4.24	4.24	7279
2.66	0.52	0.60	4.16	5.06	1.15	9.23	8.08	6.97	6.97	6961
1.30	0.88	0.76	3.12	3.79	0.58	8.63	8.05	3.80	3.80	7175
1.27	0.63	0.79	4.02	4.89	0.80	9.48	8.68	6.70	6.70	7176
2.38	0.46	0.42	3.30	4.01	0.38	8.65	8.27	4.09	4.09	7272
3.42	0.51	0.34	4.27	5.19	0.28	8.43	8.15	7.16	7.16	7439
0.82	0.61	0.42	1.95	2.37	0.60	8.63	8.03	4.35	4.35	6836
0.21	0.32	2.06	2.68	3.26	5.35	12.03	6.68	6.92	6.92	6820
0.08	0.48	0.15	8.46	10.29	1.98	8.48	6.50	5.06	8.31	6818

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Samp
	Sampled by Station:		
	The Rogers and Hubbard Co., Portland.		
7265	Hubbard's "Bone Base" Soluble Corn and General Crops	3-8-6	Branford
7543	Hubbard's "Bone Base" Soluble Corn and General Crops Manure	3-8-6	Fair Haven
6966	Hubbard's "Bone Base" Soluble Potato Manure	6-8-5	Willimantic
7183	Hubbard's "Bone Base" Soluble Tobacco Manure	6-8-10	New Milford
6846	R & H All Soils All Crops Fertilizer	4-10-4	Ellington
7182	R & H Climax Tobacco Brand	5-4-5	New Milford
6822	R & H Corn and Grain Fertilizer	1-10-3	New Britain
6841	R & H High Potash Fertilizer	3-8-10	New Britain
6821	R & H Potato Fertilizer	2-10-4	New Britain
6826	R & H Tobacco Grower Vegetable Formula	6-4-4	Ellington
	F. S. Royster Guano Co., Baltimore, Md.		
7333	Royster's Gem Guano	2-12-4	Watertown
6840	Royster's Quality Trucker	4-8-7	New Canaan
6839	Royster's Rational Guano	1-9-4	New Canaan
6842	Royster's Spearhead Guano	3-8-4	Thompsonvill
7332	Royster's Top Dresser	7-6-5	Plainville
6838	Royster's 5% Truck Guano	5-8-7	New Canaan
7480	Royster's 5% Truck Guano	5-8-7	Canton
6837	Royster's Trucker's Delight	4-8-4	New Canaan
7337	Royster's Valley Tobacco Guano 5-4-5	5-4-5	So. Windsor
	M. L. Shoemaker & Co., Philadelphia, Pa.		
7585	"Swift-Sure" Special 4-8-5	4-8-5	New Milford
6931	"Swift-Sure" Tobacco and General Use 3-10-3	3-10-3	New Milford
	Springfield Rendering Co., Springfield, Mass.		
7329	Springfield Animal Brand 3-8-4	3-8-4	Thompsonvill
7359	Springfield Market Garden Grower and Top Dresser 5-8-7	5-8-7	Stafford Sprin
7360	Springfield Special Potato, Onion and Vegetable 4-8-4	4-8-4	Stafford Sprin
7442	Springfield 4-8-7	4-8-7	Suffield
	I. P. Thomas & Son, Philadelphia, Pa.		
7173	Economy Fertilizer 3-12-3	3-12-3	North Haven
7350	I. P. Thomas 5-8-7	5-8-7	North Haven
7355	Long Island Special 4-8-7	4-8-7	Ansonia
7349	Tip Top Superphosphate 3-10-6	3-10-6	North Haven

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Continued.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
0.80	0.96	0.81	2.64	3.21	2.25	9.83	7.58	6.63	6.63	7265
.....	......	......	2.61	3.17	1.02	9.88	8.86	6.66	6.66	7543
2.12	1.04	0.88	5.10	6.20	1.99	9.88	7.89	0.70	4.97	6966
1.91	1.19	0.86	5.00	6.08	2.28	10.65	8.37	0.86	10.33	7183
2.02	0.44	0.71	3.34	4.06	0.50	10.72	10.22	4.33	4.33	6846
0.04	0.13	2.81	4.28	5.20	0.23	4.40	4.17	0.58	5.57	7182
0.35	0.27	0.44	1.21	1.47	0.50	10.60	10.10	3.79	3.79	6822
1.22	0.45	0.67	2.42	2.94	0.48	8.76	8.28	10.79	10.79	6841
0.37	0.55	0.66	1.64	1.99	0.56	10.49	9.93	4.05	4.05	6821
0.09	0.32	3.64	5.42	6.59	0.75	5.43	4.68	0.43	4.08	6826
0.98	0.12	0.51	1.74	2.11	1.18	13.30	12.12	4.02	4.02	7333
2.12	0.48	0.64	3.24	3.94	0.50	8.73	8.23	7.03	7.03	6840
0.46	0.00	0.32	0.85	1.03	1.12	9.91	8.79	4.03	4.03	6839
1.76	0.28	0.62	2.75	3.34	0.65	8.78	8.13	4.44	4.44	6842
3.00	0.84	0.91	5.53	6.72	0.68	7.03	6.35	5.02	5.02	7332
2.54	0.55	0.76	3.91	4.75	0.68	8.68	8.00	6.70	6.70	6838
2.60	0.72	0.63	3.98	4.84	0.63	8.78	8.15	6.63	6.63	7480
2.09	0.38	0.60	3.18	3.87	0.47	8.39	7.92	3.85	3.85	6837
0.94	0.29	2.47	4.14	5.03	0.25	4.50	4.25	0.57	5.03	7337
0.65	0.25	1.53	3.14	3.82	1.63	10.10	8.47	0.64	5.28	7585
1.72	0.09	0.88	2.87	3.49	0.87	10.51	9.64	0.15	3.15	6931
1.14	0.77	0.32	2.56	3.11	1.08	8.98	7.90	3.93	3.93	7329
2.27	0.73	0.77	4.15	5.05	0.78	9.06	8.28	7.05	7.05	7359
1.65	0.84	0.44	3.30	4.01	1.33	8.88	7.55	4.07	4.07	7360
1.53	0.77	0.57	3.34	4.06	1.25	9.05	7.80	6.90	6.90	7442
1.62	0.26	0.43	2.84	3.45	1.88	13.92	12.04	3.00	3.00	7173
2.69	0.50	0.69	4.21	5.12	2.13	10.33	8.20	5.97	6.79	7350
2.20	0.29	0.60	3.60	4.38	1.75	10.08	8.33	7.31	7.31	7355
1.80	0.14	0.50	2.70	3.28	1.80	11.93	10.13	5.34	6.02	7349

TABLE XII. ANALYSES OF MIXED FERTILIZERS

Station No.	Manufacturer and Brand.	Grade.	Place of Sampli[ng]
	Sampled by Station:		
	I. P. Thomas & Son, Philadelphia, Pa.		
7357	7% Guano	7-6-5	Milford
6829	Thomas Tobacco Grower	5-4-5	Talcottville
6828	Truckers' High Grade Guano 4-8-4	4-8-4	Talcottville
7174	Victor Potash Fertilizer 2-8-5	2-8-5	Ansonia
	Triton Oil and Fertilizer Co., New York		
7356	Triton 4-8-4 Fertilizer	4-8-4	Milford
7358	Triton 4-8-7 Fertilizer	4-8-7	New London
	United States Guano Co., Baltimore, Md.		
7435[1]	4-8-10	4-8-10	North Haven
7434	5-8-5	5-8-5	North Haven
7354	Standard United States Mammoth Potato Grower	2-8-10	North Haven
7352	Standard United States Royal Potato Grower.	4-8-7	North Haven
	Virginia-Carolina Chemical Co., New York.		
6938	V. C. Aroostook Potato Grower	5-8-7	New Britain
7444	V-C Fairway Fertilizer	8-6-5	Danbury
6937	V-C XXXX Fish and Potash	4-8-4	New Britain
7481	V-C XXXX Fish and Potash	4-8-4	Danbury
	Wilcox Fertilizer Co., Mystic.		
7437	Wilcox Corn Special	3-10-4	Willimantic
7436	Wilcox General Vegetable Phosphate	4-8-6	Ellington
7440	Wilcox High Grade Fish and Potash	4-8-4	Sampled at fact[ory]
7461	Wilcox Potato Fertilizer	5-8-7	Norwich
7438	Wilcox Special 4-8-4 Fertilizer	4-8-4	Willimantic
6932	Wilcox 7-6-5 Top Dresser	7-6-5	Ellington
	S. D. Woodruff & Sons, Orange.		
6930	Woodruff's Home Mixed Fertilizer	4-8-6	Sampled at fact[ory]
	Worcester Rendering Co., Auburn, Mass.		
7454	Prosperity Brand Complete Dressing	6-6-4	Groton
7451	Prosperity Brand Corn and Grain Fertilizer	2-10-2	Colchester
7453	Prosperity Brand Market Garden Fertilizer	5-8-7	Norwich
7452	Prosperity Brand Potato and Vegetable Fertilizer	4-8-4	Colchester
	Wm. P. Young, Pottstown, Pa.		
6941	Young's Formula, A Complete Fertilizer	8-7-6	Mfg's sample

[1] See note page 59.

CONTAINING NITROGEN, PHOSPHORIC ACID AND POTASH—*Concluded.*

Nitrogen.				Ammonia equivalent to total nitrogen.	Phosphoric Acid.			Potash.		Station No.
In ammonia.	Organic water-soluble.	Organic water-insoluble.	Total.		Citrate-insoluble.	Total.	So-called "Available."	As muriate.	Total.	
%	%	%	%	%	%	%	%	%	%	
4.00	0.57	0.79	5.92	7.20	1.70	8.33	6.63	4.76	5.33	7357
0.39	0.26	3.25	4.12	5.01	2.83	10.40	7.57	1.17	6.54	6829
2.06	0.22	0.59	3.43	4.17	1.56	9.58	8.02	3.82	4.30	6828
1.34	0.09	0.43	1.94	2.36	1.45	9.70	8.25	5.06	5.51	7174
1.48	0.72	0.86	3.50	4.26	0.58	8.68	8.10	3.91	3.91	7356
2.02	0.54	0.67	3.31	4.02	0.63	9.65	9.02	7.24	7.24	7358
1.12	0.07	0.57	1.89	2.30	1.18	9.23	8.05	9.04	9.04	7435
3.12	0.00	0.68	4.05	4.92	0.88	9.25	8.37	5.02	5.02	7434
0.96	0.00	0.55	1.70	2.07	1.18	9.90	8.72	8.69	8.69	7354
2.57	0.10	0.84	3.63	4.41	1.30	9.20	7.90	6.72	6.72	7352
2.88	0.51	0.67	4.08	4.96	0.88	9.13	8.25	6.72	6.72	6938
3.68	0.59	1.94	6.29	7.65	0.75	7.48	6.73	5.74	5.74	7444
2.22	0.42	0.36	3.00	3.65	1.08	9.24	8.16	3.53	3.53	6937
2.06	0.73	0.47	3.48	4.23	0.98	9.28	8.30	4.00	4.00	7481
0.06	0.56	0.50	2.37	2.88	0.68	11.13	10.45	4.49	4.49	7437
0.10	0.63	0.80	3.28	3.99	0.83	9.35	8.52	6.56	6.56	7436
0.21	0.67	0.66	3.18	3.87	0.63	8.51	7.88	3.28	4.14	7440
1.46	0.90	0.62	4.11	5.00	0.78	8.78	8.00	6.30	6.98	7461
1.22	0.67	0.46	3.27	3.98	0.55	8.93	8.38	4.05	4.05	7438
1.70	0.75	1.08	5.39	6.55	0.78	7.18	6.40	4.15	4.83	6932
0.14	0.47	2.09	4.12	5.01	1.68	8.51	6.83	5.67	7.00	6930
3.34	1.10	0.42	5.13	6.24	0.70	7.38	6.68	4.27	4.27	7454
0.89	0.49	0.30	1.68	2.04	1.07	10.25	9.18	2.09	2.09	7451
1.08	1.07	1.07	4.48	5.45	0.80	9.30	8.50	7.48	7.48	7453
1.80	0.80	0.49	3.33	4.05	0.60	8.43	7.83	4.20	4.20	7452
5.04	0.21	0.89	6.74	8.19	0.60	7.98	7.38	8.02	8.02	6941

SPECIAL MIXTURES AND HOME MIXTURES.

A considerable number of samples of this type of fertilizers are examined each year for individual purchasers or others interested. For the most part such samples are drawn and submitted by the persons interested, in which case the Station is responsible only for the analysis of the material as received. The Station agent does sample such stock in some instances upon request of purchasers.

Thirty-nine samples in this group have been analyzed during the year and the results are given in Table XV.

VIII. MISCELLANEOUS FERTILIZERS, AMENDMENTS AND OTHER MATERIALS.

SHEEP MANURE, ETC.

Seventeen samples of sheep manure and other farm manures were analyzed. While such materials do not contain large amounts of plant food (about 130 pounds to the ton usually), they have some further agricultural value as amendments and as culture media for soil bacteria.

Analyses are given in Table XVI.

LIME.

Twenty-one samples of liming materials have been analyzed during the year. Samples have been drawn and submitted largely by purchasers. Lime is not classed as a fertilizer under the fertilizer law of this State and no registration is required.

Analyses are given in Table XVII.

ation No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. So-called "available."	Potash. As muriate.	Potash. Total.	Station No.
			%	%	%	%	%	%	%	
	Sampled by Station:									
7458	Corn Fertilizer	Cornelius Ahearn, Stratford	2.62	3.19	0.90	9.70	8.80	....	5.78	7458
7457	Top Dressing	Cornelius Ahearn, Stratford	3.28	3.99	1.50	9.95	8.45	....	5.28	7457
7479	Berkshire Chemical Co., Bridgeport	F. W. Buckland, Hillstown	5.82	7.08	0.20	4.70	4.50	....	5.75	7479
7460	Tobacco Mixture	Edwards & Brewer Inc., Hockanum	5.82	7.08	0.30	4.28	3.98	....	6.16	7460
7459	Tobacco Mixture	Fred Getto, Glastonbury	5.94	7.22	0.40	3.53	3.13	....	7.94	7459
7422	International Agricultural Corp., Boston, Mass.	David Hastings, Suffield	3.54	4.30	0.08	1.30	1.22	....	8.54	7422
7441	Olds & Whipple, Inc., Hartford	L. W. Newberry, So. Windsor	5.77	7.02	0.25	6.30	6.05	....	8.43	7441
7498	Olds & Whipple, Inc., Hartford	Arthur Manning, Manchester	6.06	7.37	0.98	5.65	4.67	....	5.95	7498
7496	The Rogers & Hubbard Co., Portland	Arthur Manning, Manchester	5.73	6.97	0.85	4.78	3.93	....	5.78	7496
7456	Corn Fertilizer	T. W. Ryan, Stratford	2.70	3.28	0.63	10.68	10.05	....	6.13	7456
7455	Top Dressing	T. W. Ryan, Stratford	4.02	4.89	0.55	8.48	7.93	....	8.04	7455
	Sampled by Purchaser:									
7293	American Agricultural Chemical Co., New Haven	Michael Davis, Suffield	4.12	5.01	0.33	4.53	4.20	....	5.12	7293
7640	Apothecaries Hall Co., Waterbury	M. E. Thompson, Ellington	5.09	6.19	0.29	6.08	5.79	1.01	6.16	7640

TABLE XV. ANALYSES OF SPECIAL MIXTURES AND HOME MIXTURES—*Continued.*

Station No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to tota lnitrogen.	Phosphoric Acid.			Potash.		Station No.
					Citrate-insoluble.	Total.	So-called "available."	As muriate.	Total.	
			%	%	%	%	%	%	%	
	Sampled by Purchaser:									
6359	Formula AA.............	American Sumatra Tobacco Co., Bloomfield..................	9.86	11.99	0.82	4.29	3.47	....	0.95	6359
6210	Formula A..............	American Sumatra Tobacco Co., Bloomfield..................	5.90	7.17	0.46	4.39	3.93	....	5.48	6210
6307	Formula A..............	American Sumatra Tobacco Co., Bloomfield..................	5.69	6.92	0.56	4.91	4.35	....	5.07	6307
6308	Formula B..............	American Sumatra Tobacco Co., Bloomfield..................	5.40	6.57	0.91	5.82	4.91	....	7.49	6308
6309	Formula C..............	American Sumatra Tobacco Co., Bloomfield..................	4.93	5.99	1.56	5.77	4.21	....	7.81	6309
6850	Formula C..............	American Sumatra Tobacco Co., Bloomfield..................	4.88	5.93	1.20	5.90	4.70	....	8.10	6850
6360	Formula D..............	American Sumatra Tobacco Co., Bloomfield..................	5.82	7.08	0.20	4.16	3.96	....	5.79	6360
6361	Formula E..............	American Sumatra Tobacco Co., Bloomfield..................	5.90	7.17	0.69	5.24	4.55	....	.....	6361
6851	Formula E..............	American Sumatra Tobacco Co., Bloomfield..................	5.82	7.08	0.58	5.05	4.47	....	5.80	6851
5533	Fall Tobacco Bed Fertilizer	American Sumatra Tobacco Co., Bloomfield..................	5.32	6.47	0.92	5.97	5.05	0.74	5.74	5533
7131	Tobacco Bed Starter......	American Sumatra Tobacco Co., Bloomfield..................	7.00	8.51	3.08	9.40	6.32	....	.....	7131

Station No.	Manufacturer or Brand.	Place of Sampling.	Total Nitrogen.	Ammonia equivalent to total nitrogen.	Phosphoric Acid. Citrate-insoluble.	Phosphoric Acid. Total.	Phosphoric Acid. So-called "available."	Potash. As muriate.	Potash. Total.	Station No.
	Sampled by Purchaser:		%	%	%	%	%	%	%	
7511	Armour Fertilizer Works, New York	Mrs. Ruth P. Bartlett, East Windsor	3.55	4.32	0.28	5.40	5.12	....	4.85	7511
5449	....	Allan J. Bartlett, Greenwich	5.95	7.23	3.57	11.54	7.97	....	3.62	5449
6953	....	Daigle Bros., Marion	3.88	4.72	....	10.60	....	....	8.78	6953
6423	....	Joseph E. Drepeau, New Milford.	4.16	5.06	0.15	5.36	5.21	....	6.03	6423
7040	L. T. Frisbie Co., New Haven	A. E. Plant & Sons, Branford	4.22	5.13	0.98	9.25	8.27	....	6.86	7040
6803	....	L. B. Haas & Co. Inc., Hartford.	5.28	6.42	....	8.90	....	....	12.52	6803
7039	Lowell Fertz. Co., Boston, Mass.	A. E. Plant & Sons, Branford	3.95	4.80	0.54	10.59	10.05	....	5.30	7039
7492	Lowell Fertz. Co., Boston, Mass.	Paul Liebman, Ellington	4.26	5.18	0.70	9.30	8.60	....	5.98	7492
7043	Olds & Whipple, Inc., Hartford	Henry E. Wells, Warehouse Point	5.15	6.26	0.18	6.43	6.25	....	13.12	7043
7044	Olds & Whipple, Inc., Hartford	Henry E. Wells, Warehouse Point	5.36	6.52	0.18	6.15	5.97	....	13.43	7044
7229	The Rogers & Hubbard Co., Portland	Henry P. Smith, Glastonbury	6.17	7.50	1.03	4.75	3.72	....	6.65	7229
7045	....	Henry E. Wells, Warehouse Point	5.13	6.24	0.28	6.30	6.02	....	7.75	7045
7046	....	Henry E. Wells, Warehouse Point	3.76	4.57	0.38	7.83	7.45	....	4.52	7046
6988	....	I. D. Woodworth, Hartford	5.90	7.17	0.53	4.25	3.72	....	4.21	6988
6670	Worcester Rendering Co., Auburn, Mass.	Walter Scott, Niantic	6.68	8.12	0.63	6.93	6.30	....	6.72	6670

TABLE XVI. ANALYSES OF

Station No.	Manufacturer or Brand.	Place of Sampling.
	Sampled by Station:	
6763	Pulverized. American Agricultural Chemical Co., New York........	Geo. S. Phelps & Co., Thompsonville............
6876	Liberty. Apothecaries Hall Co., Waterbury.....................	F. B. Newton, Plainville.....
6812	Armour Fertilizer Works, New York	F. C. Benjamin, Danbury....
6742	Berkshire Chemical Co., Bridgeport	F. S. Bidwell Co., Windsor Locks....................
6673	Case Brand Pulverized. A. H. Case & Co., Buffalo, N. Y............	Frank Libner & Son, Norwalk
7340	Corenco. Consolidated Rendering Co., Boston, Mass...............	Dennis Grain Mill, Stafford Springs..................
7093	Davey Shredded Cattle Manure Davey Tree Expert Co., Kent, Ohio	R. E. Landis, Sound Beach...
6901	"Sheepshead" Pulverized. Natural Guano Co., Aurora, Ill...........	Cadwell & Jones, Hartford...
6738	Groz-It. Pacific Manure & Fertilizer Co., San Francisco, Cal..........	W. S. Eaton, Plainville.......
6905	Premier Brand Poultry Manure. Premier Poultry Manure Co., Chicago, Ill....................	Lightborn & Pond, New Haven
6906	Premier Brand Sheep Manure. Premier Poultry Manure Co., Chicago, Ill....................	Lightborn & Pond Co., New Haven..................
6895	Wizard Brand Pulverized Sheep Manure. The Pulverized Manure Co., Chicago, Ill................	S. P. Strople, New Britain....
6917	Wizard Brand Cattle Manure. The Pulverized Manure Co., Chicago Ill............................	S. P. Strople, New Britain....
6920	Wonder Grower Brand Pulverized Sheep Manure. Rocky Mountain Fertz. Co., Helena, Mont........	C. W. Lines Co., New Britain.
7180	F. S. Royster Guano Co., Baltimore Md............................	W. S. Brown, Trumbull......
6819	Toro. S. D. Woodruff & Sons, Orange........................	Gabriel Dadio, Highwood....
	Sampled by Purchaser:	
5192	....	S. D. Woodruff & Sons, Orange

SHEEP MANURE, ETC.

Total nitrogen.	Ammonia equivalent to total nitrogen.		Phosphoric acid.				Potash.		Station No.
			Available.		Total.				
	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	
%	%	%	%	%	%	%	%	%	
1.45	1.76	1.75	....	....	1.03	0.50	2.41	2.00	6763
1.30	1.58	1.80	....	....	0.77	1.00	2.24	2.00	6876
1.58	1.92	1.50	....	....	1.10	1.00	3.22	2.00	6812
3.12	3.79	3.00	....	....	....	....	....	....	6742
2.28	2.77	1.21	3.63	1.00	3.94	1.25	1.07	1.00	6673
1.38	1.68	1.50	0.63	....	0.78	0.50	2.68	2.00	7340
1.88	2.29	1.00	1.00	1.00	1.25	1.00	2.16	1.00	7093
2.38	2.89	2.73	....	0.25	2.13	1.25	2.82	2.00	6901
1.54	1.87	1.82	....	....	1.13	1.25	2.81	3.00	6738
4.89	5.95	6.00	2.48	2.50	2.60	2.75	1.28	1.30	6905
2.00	2.43	2.00	....	0.80	0.85	1.00	2.02	2.00	6906
1.75	2.13	2.43	....	1.25	1.45	....	2.67	2.00	6895
1.88	2.29	2.10	1.02	1.00	1.20	....	1.79	1.00	6917
1.77	2.15	2.43	....	....	1.13	1.20	2.83	2.00	6920
1.83	2.22	....	0.60	1.00	0.70	....	2.14	2.00	7180
1.58	1.92	1.94	....	1.00	1.08	....	3.14	2.00	6819
1.73	2.10	....	....	....	1.28	....	3.55	....	5192

TABLE XVII. ANALYSES OF

Station No.	Manufacturer or Brand.	Sampled by.
	Coe Lime Works, Northford.	
6353	Limestone	Sidney Edwards, Middletown
6662	Limestone	M. F. Morgan
6708	Limestone	New Haven County Farm Bureau
	The Connecticut Agstone Co., Danbury.	
7599	Lime	Stephen H. Brown, Woodbury
7147	Ground Limestone	Raymond Clapp, New Haven Farm Bur
	Conn. Lime Co., Canaan.	
7003	Hydrated Lime	Woodbury Coop. Assoc., Woodbury
	Grangers Mfg. Co., West Stockbridge, Mass.	
5072	Hydrated Lime	Hatheway & Steane, Inc., Hartford
6709	Limestone	New Haven County Farm Bureau
6916	Limestone	Chas. R. Treat, Orange
	Kelly Island Lime & Transport Co., Cleveland, Ohio	
7600	Hydrated Builders Lime	B. A. Brown, Storrs
	Miller Lime Products Corp., West Stockbridge, Mass.	
7002	Limestone	Woodbury Coop. Assoc., Woodbury
7473	Monarque Brand Agricultural Lime	Station agent from stock of H. F. Joy, W
7472	Monarque Brand Agricultural Lime	Station agent from stock of H. F. Joy, W
5137	Lime	C. N. Herold, New Canaan
7004	Hydrated Lime	Woodbury Coop. Assoc., Woodbury
7601	Hydrated Builders Lime	B. A. Brown, Storrs
	Warner-Miller Co., New Haven.	
7146	Hydrated Lime	Raymond Clapp. New Haven Farm Bu
	U. S. Gypsum Co., Genoa, Ohio.	
7410	Ivory Finishing Lime	P. J. Anderson, Windsor
	Manufacturer Unknown.	
5901	Limestone	Robert Coe, Durham
7021	Hydrated Lime	Mr. Putnam, Sharon
7388	Lime	J. E. Phelps, Suffield

LIMESTONE, ETC.

Chemical Analysis.					Mechanical Analysis.					
).	Magnesia (MgO).									
Guaranteed.	Found.	Guaranteed.	Total Oxides.	Insoluble in acid.	20 mesh.	40 mesh.	50 mesh.	80 mesh.	100 mesh.	Station No.
%	%	%	%	%	%	%	%	%	%	
...	0.72	....	54.89	....	92.00	75.00	63.00	53.00	51.00	6353
...	0.73	.....	53.43	.....	89.00	72.00	62.50	54.50	51.50	6662
...	0.96	.....	53.63	.....	89.00	69.00	58.00	48.00	42.50	6708
...	6.39	.....	44.61	.....	.....	.....	.....	.....	.....	7599
...	6.96	.....	45.24	.....	96.00	87.00	79.00	67.00	63.00	7147
...	22.82	.....	70.60	.....	78.00	46.00	31.00	21.00	19.00	7003
...	3.61	.....	57.45	.....	.....	.....	.....	.....	.....	5072
...	7.15	.....	47.35	.....	97.50	85.50	72.00	54.00	43.50	6709
...	1.39	.....	53.90	.....	100.00	100.00	99.00	91.00	87.50	6916
...	31.99	.....	79.25	.....	100.00	100.00	99.50	99.30	98.50	7600
...	10.69	.....	49.90	.....	100.00	92.00	84.00	74.00	70.50	7002
.87	9.85	13.72	50.77	.....	100.00	92.50	84.00	72.00	53.00	7473
.87	11.14	13.72	49.52	.....	100.00	93.00	84.50	75.00	63.00	7472
...	30.74	.....	74.66	1.42	89.00	59.00	49.00	42.00	40.00	5137
...	32.14	.....	80.67	.....	100.00	100.00	99.50	95.50	93.50	7004
...	26.11	.....	71.09	.....	94.50	94.00	94.00	93.80	89.00	7601
...	27.46	.....	70.24	.....	92.00	61.00	48.00	28.00	23.00	7146
...	31.80	.....	78.84	.....	100.00	100.00	99.00	96.00	92.00	7410
...	.....	.....	.....	.....	92.50	75.00	64.00	54.00	51.00	5901
...	32.88	.....	80.31	.....	.....	.....	.....	.....	.....	7021
...	31.72	.....	78.74	.....	100.00	100.00	99.50	93.00	72.00	7388

OTHER MISCELLANEOUS MATERIALS.

Thirty-four samples of miscellaneous materials have been examined for fertilizer ingredients, and are summarized in the following Table, XVIII.

COLLABORATIVE WORK.

The laboratory has continued to collaborate in the check meal program of the American Oil Chemists' Society, and in a similar program of check fertilizer analyses sponsored by the F. S. Royster Guano Co. Thirty samples of cottonseed meal were analyzed for nitrogen; and twelve samples of mixed fertilizers were analyzed for nitrogen, phosphoric acid and potash.

Table XVIII. Miscellaneous Materials.

No.	Material	Nitrogen	Phosphoric acid	Potash	Remarks
6079	Ashes from factory refuse (American Brass Co.).....	....	0.18	0.14	Small amount of scrap metal sifted out before analysis.
5985	Ash from Grape Pomace....	....	5.74	18.62	....
6664	Chicken Manure...........	6.35	1.82	1.15	....
6817	Chicken Manure...........	6.35	1.83	1.20	....
7250	Cottonseed Hulls...........	0.61	....	....	....
6349	Garbage Waste (Dept. of Parks, Bridgeport)........	1.54	....	....	As received 45.8% water, 17.9% ash, 36.3% organic matter. Probably not over 40 lbs. plant food in a ton.
6106	Humus (Abington).........	1.54	....	....	As received 54.8% water, 5.3% ash, 39.9% organic matter.
6107	Humus (Abington).........	1.03	....	....	As received 25.6% water, 41.5% ash, 32.9% organic matter.
5640	Locust Meal (Dried and ground locusts from Argentine)..............	7.68	1.67	0.98	Contained 3.3% insoluble organic nitrogen which was about 60% "active" by usual methods.
5063	Mineral...................	....	....	....	Contained iron and small amount of copper.
6832	Mineral...................	....	....	....	Sandstone with particles of pyrites.
5193	Nitrogen base goods. (Olds & Whipple, Inc.).........	9.33	....	....	Contained 8% insoluble organic nitrogen 75% of which was "active" by usual laboratory methods.
6351	Peat Moss.................	0 92	trace	1.07	As received 16% water, 1.6% ash, 82.4% organic matter. Oat straw on same water basis contains about 0.6% N., 0.3% P_2O_5, and 1.8% K_2O.

TABLE XVIII. MISCELLANEOUS MATERIALS—*Concluded.*

No.	Material	Nitrogen	Phosphoric acid	Potash	Remarks
5116	Sewage Sludge (dried)	0.51	....	....	....
6350	Sewage Sludge (Dept. of Parks, Bridgeport)	0.40	....	....	As received 82.4% water, 3.5% ash, 14.1% organic matter. One ton contains not over 10 lbs. of plant food.
7567	Soil	....	....	....	A trace of chloride.
7568	Soil	....	....	....	A trace of chloride.
6929	Soot (Flue deposit from incinerator)	0.06	1.45	1.20	....
7165	Sulphate of ammonia	0.20	....	....	Not sulphate of ammonia; probably potassium sulphate.
5879	Swamp humus (Warehouse Point)	0.66	....	....	As received 69.5% water, 6.2% ash, 24.3% organic matter.
5880	Swamp humus (Windsor)	2.41	....	....	As received 11.9% water, 8.3% ash, 79.8% organic matter. Useful as an absorbent and conditioner. Amount of plant food small and slowly available in such material.
7194	Swamp Muck (West Suffield)	0.23	....	....	As received 87.5% water, 3.2% ash, 9.3% organic matter.
6425	Tobacco Dust	2.30	0.46	2.29	....
6546	Tobacco Dust	0.98	0.46	1.47	....
7606	Tobacco Dust	3.38	0.60	2.90	....
5220	Tobacco Stems	2.31	0.50	8.37	....
5308	Tobacco Stems	2.31	0.57	4.33	Nicotine 1.01%
5309	Tobacco Stems	3.02	0.68	7.79	Nicotine 0.05%
5990	Tobacco Stems	2.87	....	8.64	....
6208	Tobacco Stems	2.91	0.65	8.93	....
6302	Tobacco Stems	2.67	0.52	4.79	....
6357	Tobacco Stems	2.66	0.43	4.77	....
6424	Tobacco Stems	2.14	0.43	3.48	....
6547	Tobacco Sweepings	1.58	0.61	2.03	....

INDEX

	Page
American Agricultural Chemical Company, New Haven Sales Dept., New Haven, Conn.:	
A. A. C. 16% Acid Phosphate (See Superphosphate)	7, 38
AAC Tobacco Ash Element	7
AAC Tobacco Starter	7, 62
Acme Fertilizer	7, 62
Aroostook Potato Manure	7, 62
Castor Pomace	7, 22, 23
Complete General Fertilizer	7, 62
Cotton Seed Meal	3, 7, 27, 28
Double A Tobacco Fertilizer	7, 62
Double Manure Salts	7, 41, 44
Dry Ground Fish	7, 48, 49
Fine Ground Bone	7, 52, 54
Gladiator Fertilizer	7, 62
Grass and Lawn Top Dressing	7, 62
Hi-Grade Tobacco Manure	7, 62
Monarch Fertilizer	7, 62
Muriate of Potash	7, 40, 42
Nitrate of Soda	7, 18, 19
Old Hickory Fertilizer	7, 62
Patapsco 5-8-7 Fertilizer	7, 62
Pulverized Sheep and Goat Manure	7, 78, 82, 83
Sulphate of Potash	7, 41, 43
Bowker's All Round Fertilizer	7, 62
Market Garden Fertilizer	7, 62
Potato and Vegetable Phosphate	7, 62
Stockbridge Early Crop Manure	7, 62
Stockbridge Hill and Drill Fertilizer	7, 62
Stockbridge Tobacco Manure	7, 62
Sure Crop Fertilizer	7, 62
Bradley's Blood, Bone and Potash	7, 62
Complete Manure for Potatoes and Vegetables	7, 62
Complete Tobacco Manure	7, 62
Eclipse Fertilizer	7, 62
Northland Potato Grower	7, 62
Potato Fertilizer	7, 62
Potato Manure	7, 62
XL Superphosphate of Lime	7, 62
National Aroostook Special Fertilizer	7, 62
Complete Tobacco Fertilizer	7, 62
Market Garden Fertilizer	7, 62
Pine Tree State Potato Fertilizer	7, 62
Premier Potato Manure	7, 62
Sanderson's 5-8-7 Fertilizer	7, 62, 64
5-10-5 Fertilizer	7, 64
3-12-3 Fertilizer	7, 64
Atlantic Coast Mixture	7, 62
Complete Tobacco Grower	7, 62
Corn Superphosphate	7, 62
Formula A	7, 62
Formula B	7, 62
Potato Manure	7, 62
Ammonium Sulphate	18
analyses of	20
American Cyanamid Company, 535 Fifth Ave., New York City.:	
Ammo-Phos 20-20	8

	Page
Apothecaries Hall Company, Waterbury, Conn.:	
Acid Phosphate (See Superphosphate)	8, 38
Bone Meal 4-20	8, 52, 54
Bone Meal 3-22	8, 52, 54
Bone & Meat Tankage	8, 52, 53
Carbonate of Potash	8, 40, 42
Castor Pomace	8, 22, 23
Double Sulphate Potash and Magnesia	8, 41, 44
Dry Ground Fish	8, 48, 49
Liberty Corn and All Crops 2-8-2	8, 64
Corn, Fruit and All Crops 2-12-4	8, 64
Fish Bone and Potash 3-8-3	8, 64
High Grade Market Gardeners 5-8-7	8, 64
High Grade Tobacco Manure 7-4-7	8
Home Vegetable Garden Fertilizer	8, 64
Lawn Fertilizer	8
Onion Special (Potash as Sulphate) 4-8-7	8, 64
Potato and General Crops 4-8-10	8, 64
Potato and Market Gardeners Special 4-8-4	8, 64
Potato and Vegetable 2-8-10	8, 64
Sheep Manure	8, 82
Tobacco Special 5-4-5	8, 64
Top Dresser for Grass and Grain 10-3½-8	8, 64
Muriate Potash	8, 40, 42
Nitrate Soda	8, 18, 19
Nitrate Soda and Potash	8, 47
Precipitated Bone	8, 35, 36
Sulphate Potash	8, 41, 43
Tankage	8, 52, 53
Armour Fertilizer Works, 50 Broad St., New York City.:	
Armour's Big Crop Acid Phosphate 16% (See Superphosphate)	8, 38
Big Crop Bone Meal 3-48	8, 52, 54
Big Crop Fertilizer 8-6-6	8, 64
Big Crop Fertilizer 5-8-7	8, 64
Big Crop Fertilizer 4-6-10	8, 64
Big Crop Fertilizer 4-8-7	8
Big Crop Fertilizer 4-8-4	8, 64
Big Crop Fertilizer 4-16-4	8, 64
Big Crop Fertilizer 3-8-4	8, 64
Big Crop Fertilizer 2-12-4	8
Big Crop Super Phosphate 20%	8
Big Crop Tobacco Special 5-4-5	8, 64
Castor Pomace 5½%	8, 23
Corn Grower 2-8-2	8, 64
Cotton Seed Meal 8%	8, 28
Dried Ground Fish 10%	8, 48, 49
Ground Tankage 9%	8
Lawn and Garden Grower 6-8-6	8
Muriate of Potash 48%	8, 40, 42
Nitrate of Soda 18%	8, 18, 19
Sheep Manure 1½-1-2	8, 82
Sulphate of Potash 48%	8, 41, 43
Ashcraft-Wilkinson Company, Atlanta, Ga.:	
Helmet Brand	3, 9, 27, 29
Monarch Brand	3, 9, 27, 29
Paramount Brand	3, 9, 27, 29
Atlantic Packing Company, New Haven, Conn.:	
Atlantic Grain Fertilizer 2-10-2	9, 64
Special Vegetable 4-8-4	9, 64
Tobacco Grower 5-4-5	9

Page

Atlantic Packing Company—*Cont'd.*
Atlantic Tobacco Manure 5-8-6 .... 9, 64
5-4-16 .... 9, 64
Baker Castor Oil Company, 120 Broadway, New York City.:
Castor Pomace 9, 22, 23, 24
E. J. Bantle, Glastonbury, Conn.:
Bantle's Wrapper Brand 9, 66
Barrett Company, 40 Rector St., New York City.:
Arcadian Sulphate of Ammonia 9, 18, 20
The F. A. Bartlett Tree Expert Co., Stamford, Conn.:
Bartlett's Green Tree Food 9, 66
The Berkshire Chemical Company, Bridgeport, Conn.:
Berkshire Acid Phosphate (See Superphosphate) 9, 38
Castor Pomace 9, 22, 25
Complete Fertilizer 9, 66
Complete Tobacco 9, 66
Dry Ground Fish 9, 48, 49
Economical Grass Fertilizer 9, 66
Fine Ground Bone 9, 52, 54
Grass Special 9, 66
Long Island Special 9, 66
Market Garden Fertilizer 9, 66
Potato and Vegetable Phosphate 9, 66
Sheep Manure 9, 78, 82
Starter with 10% Potash 9, 66
Tobacco Special 9, 66
Boardman's Complete Fertilizer 9
High Grade Sulphate Potash 9, 41, 43
Muriate Potash 9, 41, 42
Nitrate of Soda 9, 18, 19
Precipitated Bone Phosphate 9, 35, 36
Bone Phosphate 35
analyses of 36
Amos D. Bridge's Sons, Incorporated, Hazardville, Conn.:
Corn, Onion and Potato and General Purpose 9, 66
Special Tobacco Fertilizer 9, 66
F. W. Brode Corporation, Memphis, Tenn.:
Owl Brand 41% Cotton Seed Meal 3, 9, 27, 29, 30
Calcium Nitrate, *(Nitrate of Lime), analyses of* 21
A. H. Case & Company, Incorporated, Buffalo, N. Y.:
Case's *Brand Pulverized Sheep Manure* 9, 78, 82
Castor Pomace 22
analyses of 23
The E. D. Chittenden Company, 1115 Main St., Bridgeport, Conn.:
Chittenden's Acid Phosphate (See Superphosphate) 10, 38
Castor Pomace 10, 22, 25
Complete Grain 10, 66
High Grade Potato 7% Potash 10, 66
High Grade Tobacco 10
Nitrate of Soda 10, 18, 19
Potato Special 4% Potash 10, 66
Special Top Dresser 10
Tobacco Special 10, 66
Tobacco Starter 10, 66
Vegetable and Onion Grower 10, 66
Fine Ground Bone 10, 52, 54
Everett B. Clark Seed Company, Milford, Conn.:
16% Acid Phosphate (See Superphosphate) 10, 38
Nitrate of Soda 10, 18, 19
Special Mixture for General Use 10, 66

Everett B. Clark Seed Company—*Cont'd.* Page
Special Mixture with 6% Potash........ 10, 66
Super Phosphate........ 10, 66
Tip Top Brand........ 10, 66
Commercial Deficiencies, table of........ 59
The Conn. Fat Rendering & Fertilizer Corp., New Haven, Conn.:
Tankage........ 10, 52, 53
Consolidated Rendering Company, 40 North Market St., Boston, Mass.:
Acid Phosphate (See Superphosphate)........ 10, 38
Castor Pomace........ 10, 22, 25
Corenco Sheep Manure........ 10, 78, 82
Dry Ground Fish........ 10, 48, 49
Ground Bone........ 10, 52, 54
Muriate of Potash........ 10, 40, 42
Nitrate of Soda........ 10, 18, 19
Sulphate of Ammonia........ 10, 18, 19
Sulphate of Potash........ 10, 41, 43
Tankage 6-30........ 10, 52, 53
Tankage 9-20........ 10, 52, 53
Cottonseed Hull Ashes........ 11, 41
analyses of........ 44
Cottonseed Meal........ 3, 27, 28
analyses of........ 28
C. A. Cowles, Plantsville, Conn.:
C. A. Cowles 4-8-4 Fertilizer........ 10, 66
C. & R. Sales Co., Worcester, Mass.:
C. & R. Lawn Shrub........ 10, 66
Davey Tree Expert Company, Inc., Kent, Ohio.:
Davey Shredded Cattle Manure........ 10, 82
Davey Tree Food........ 10, 66
Dry Ground Fish........ 48
analyses of........ 49
Eastern States Farmers' Exchange, 33 Lyman St., Springfield, Mass.:
Eastern States Acid Phosphate (See Superphosphate)........ 10, 38
Fine Bone Meal........ 10, 52, 54
High Analysis Fertilizer 8-16-20........ 10, 68
High Analysis Fertilizer 10-16-14........ 10, 68
High Analysis Fertilizer 8-16-8........ 10
High Analysis Fertilizer 4-16-4........ 10
Muriate of Potash........ 10, 40, 43
Nitrate of Soda........ 11, 18, 19
No Filler 3-12-3........ 11, 68
No Filler Fertilizer 4-8-10........ 11, 68
No Filler 5-8-7........ 11, 68
No Filler Fertilizer 5-10-5........ 11, 68
No Filler Fertilizer 8-6-6........ 11, 68
Open Formula A Tobacco Fertilizer........ 11, 68
Sulphate of Ammonia........ 11, 18, 20
Sulphate of Potash........ 11
Ed. Eggert, Hartford, Conn.:
Cotton Seed Hull Ashes........ 11, 41, 44, 45
Essex Fertilizer Company, 39 North Market St., Boston, Mass.
Essex A1 Superphosphate 2-10-2........ 11, 68
Complete Manure 5-8-7........ 11, 68
Fish Fertilizer, For All Crops 3-8-4........ 11, 68
Market Garden 4-8-4........ 11, 68
Tobacco Grower 5-4-5........ 11, 68
Top Dressing 7-6-5........ 11, 68

Page

Fertilizer, check samples.......... 87
  law, provisions of.......... 3
Fertilizers, analyses of mixed.......... 57
  classification of samples analyzed.......... 17
  containing nitrogen and phosphoric acid
    analyses of.......... 57
  containing nitrogen and potash.......... 47
  containing phosphoric acid and potash.......... 57
  containing ammonia, phosphoric acid and potash
    analyses of.......... 62
  gratuitous analyses of.......... 6
  inspection of.......... 17
  precautions to be observed in drawing samples of.......... 5
Ford Motor Company, Detroit, Michigan.:
  Ford Ammonium Sulphate.......... 11, 18, 20
Four Seasons Fertilizer Co., Inc., 135 West 29th St., New York City.:
  Four Seasons Fertilizer.......... 11
L. T. Frisbie Co., New Haven, Conn.:
  Frisbie's Corn and Grain Fertilizer 2-10-2.......... 11, 68
    Fine Bone Meal.......... 11, 52, 54
    5-8-7.......... 11, 68
    Market Garden 4-8-7.......... 11, 68
    Special 3-8-4.......... 11, 68
    Special Vegetable and Grower 4-8-4.......... 11, 68
    Tobacco Grower 5-4-5.......... 11, 68
    Tobacco Manure 5-8-6.......... 11, 68
    Top Dresser 7-6-5.......... 11, 68
    3-50 Bone Meal.......... 11, 52, 54
Grasselli Chemical Company, Cleveland, Ohio.:
  Grasselli Odorless Plant Food.......... 11
Ground Bone.......... 52
    analyses of.......... 54
Home Mixtures.......... 78
    analyses of.......... 79
Humphreys-Godwin Company, Memphis, Tenn.:
  Bull Brand Cottonseed Meal.......... 3, 11, 27, 31, 33
  Danish Brand Cottonseed Feed.......... 3, 11, 27
  Dixie Brand Cottonseed Meal.......... 3, 11, 27, 30, 31, 32, 33
International Agricultural Corporation, 126 State St., Boston, Mass.:
  Acid Phosphate (See Superphosphate).......... 11, 38
  Basic Slag.......... 11
  Bone Meal.......... 11, 52, 54
  Castor Pomace.......... 11
  Cottonseed Meal 43%.......... 3, 11, 27
  I. A. C. Connecticut Valley Special.......... 11, 68
    Crop Grower.......... 11, 68
    General Favorite.......... 11
    High Grade Manure.......... 11, 68
    Ideal.......... 12, 68
    New England Special.......... 12
    Nitrate of Soda.......... 12, 18, 19
    Tobacco Producer.......... 12, 68
  Rainbow Brand Cottonseed Meal.......... 3, 12, 27, 33
  Special 4-8-6.......... 12, 68
  Sulphate of Potash.......... 12, 41, 43
  Tankage.......... 12
John Joynt, Lucknow, Ontario, Canada.:
  Joynt Brand, Wood Ashes.......... 12, 41, 46

	Page
Spencer Kellogg & Sons, Inc., Buffalo, N. Y.:	
Castor Pomace	12
Linseed Meal	12, 27, 35
Kuttroff, Pickhardt & Co., Inc., 1150 Broadway, New York City.:	
Calcium Nitrate B. A. S. F. (Nitrate of Lime)	12, 21
Urea B. A. S. F. (Floranid)	12, 21
Lime	78
analyses of	84, 85
Linseed Meal	27, 35
Lowell Fertilizer Company, 40 North Market St., Boston, Mass.:	
Lowell Animal Brand A High Grade Manure 3-8-4	12, 68
Bone Fertilizer 2-10-2	12, 70
Corn and Vegetable 4-8-4	12, 70
Market Garden Manure 5-8-7	12, 70
Potato Phosphate 4-8-7	12, 70
Top Dressing 7-6-5	12, 70
Tobacco 5-4-5	12, 70
8-6-6	12, 70
5-10-5	12, 70
3-12-3	12, 70
L. B. Lovitt & Company, Memphis, Tenn.:	
"Lovit Brand" 41%	3, 12, 27, 33
"Lovit Brand" 43%	3, 12, 27, 33
The Mapes Formula Peruvian Guano Co., 270 Madison Ave., New York City.:	
The Mapes Connecticut Valley Special	12, 70
Corn Manure	12, 70
General Tobacco Manure	12, 70
General Truck Manure	12, 70
General Use Manure	12, 70
Onion Manure	12, 70
Potato Manure	12, 70
Special Trucker	12, 70
Tobacco Ash Constituents	12, 70
Tobacco Ash and Starter	12, 70
Tobacco Manure, Wrapper Brand	12, 70
Tobacco Starter Improved	12, 70
Top Dresser	12, 70
Pure Fine Ground Bone	12, 52, 54
Nitrate of Soda	12, 18, 19
Sulphate of Potash	12, 41, 43
A. G. Markham & Company, Springfield, Mass.:	
4-8-7	13, 70
5-8-7	13, 70
Memphis Cottonseed Products Company, Memphis, Tenn.:	
Durham Forty-Three Cottonseed Meal	3, 13, 27, 34
Miscellaneous Fertilizers	86
Mixed Fertilizers	57
analyses of	62
Natural Guano Company, Aurora, Illinois.:	
"Sheep's Head" Pulverized Sheep Manure	13, 78, 82
R. N. Neal & Company, Memphis, Tenn.	
"Triangle" Brand 41%	3, 13, 27, 34
New England Fertilizer Company, 40A North Market St., Boston, Mass.:	
New England Complete Manure 4-6-10	13, 70
Corn Phosphate 2-10-2	13, 70
Market Garden Manure 5-8-7	13, 70
Potato and Vegetable Manure 4-8-4	13, 70

New England Fertilizer Company—*Cont'd.* Page
New England Superphosphate A High Grade Fertilizer For All
Crops 3-8-4 .... 13, 70
Tobacco Manure 5-4-5 .... 13, 70
Top Dressing 7-6-5 .... 13, 70
New England Standard Nine 61
Nitrate of Soda 18
analyses of 19
Olds & Whipple, Inc., Hartford, Conn.:
O & W Acid Phosphate (See Superphosphate) 13, 38
Castor Pomace 13, 22, 26
Complete Market Garden Fertilizer 13, 72
Complete Tobacco Fertilizer 13, 72
Dry Ground Fish 13, 48, 49
Grain and General Crop Fertilizer 13, 72
Grass Fertilizer 13, 72
High Grade Starter and Potash Compound 13, 72
High Grade Tobacco Starter 13
High Grade Vegetable and Potato Fertilizer 13, 72
Nitrate of Soda 13, 18, 19
Precipitated Bone 13, 35, 36
Pure Bone Meal 13, 52, 54
Tobacco Fertilizer, Blue Label Brand 13, 72
High Grade Carbonate of Potash, 96-98 .... 13, 40, 42
High Grade Sulphate of Potash 13, 41, 43
Old Deerfield Fertilizer Co., Inc., South Deerfield, Mass.:
Old Deerfield Castor Pomace 13
7-4-7 .... 13, 72
5-8-7 .... 13, 72
Pacific Manure & Fertilizer Co., 429 Davis St., San Francisco, Cal.:
Grozit Brand (Pulverized Sheep Manure) 13, 78, 82
Parmenter & Polsey Fertilizer Company, 41 North Market St., Boston, Mass.:
"P & P" "AA" Brand 5-8-7 .... 13, 72
Maine Potato Fertilizer 4-6-10 .... 13, 72
Plymouth Rock Brand For All Crops 3-8-4 .... 13, 72
Parmenter & Polsey Corn and Vegetable 4-8-4 .... 13, 72

Piedmont Mt. Airy Guano Co., Baltimore, Md.:
Harvest Brand 16% Acid Phosphate (See Superphosphate) 14, 38
2-8-2 14
3-8-4 14
4-6-10 14
4-8-4 14
5-8-7 14
Muriate of Potash 14
Nitrate of Soda 14, 18, 19
Piedmont 16% Acid Phosphate (See Superphosphate) 14, 38
4-8-10 Fertilizer 14
5-8-7 Fertilizer 14, 72
8-6-6 Fertilizer 14, 72
4-6-10 Fertilizer 14, 72
Plow Brand 14, 72
Unexcelled Guano 14, 72
Steam Bone 14, 52, 55

Frank S. Platt Co., 450 State St., New Haven, Conn.:
Platco Special 5-8-7 .... 14, 72
Potash, Carbonate of 40
analyses of 42

	Page
Potash, Muriate of	40
analyses of	42
Sulphate of	41
analyses of	43
Potash-Magnesia, sulphate of	41
analyses of	44
Premier Poultry Manure Co., 431 So. Dearborn St., Chicago, Illinois.:	
Premier Brand Poultry Manure	14, 78, 82
Sheep Manure	14, 78, 82
The Pulverized Manure Co., 828 Exchange Ave., Chicago, Illinois.:	
Wizard Brand Cattle Manure	14, 78, 82
Pulverized Sheep Manure	14, 78, 82
Rackliffe Brothers Company, Inc., New Britain, Conn.:	
4-8-4 Rackliffe Brand	14, 72
5-8-7 Rackliffe Brand	14, 72
Nitrate of Soda	14, 18, 20
Registrations	7
Rocky Mountain Fertilizer Co., Helena, Mont.:	
Wonder Grower Pulverized Sheep Manure	14, 78, 82
The Rogers & Hubbard Company, Portland, Conn.:	
4-8-4	14, 72
5-8-7	14, 72
Acid Phosphate (See Superphosphate)	14, 38
Garden Fertilizer	14, 72
Hubbard's "Bone Base" Fertilizer for Seeding Down	14, 72
Oats and Top Dressing	14, 72
Soluble Corn and General Crops Manure	14, 74
Soluble Potato Manure	14, 74
Soluble Tobacco Manure	14, 74
Pure Raw Knuckle Bone Flour	14
Strictly Pure Fine Bone	14, 52, 55
Nitrate of Potash	14, 47
Rogers & Hubbard's All Soils-All Crops Fertilizer	14, 74
Climax Tobacco Brand	14, 74
Corn and Grain Fertilizer	14, 74
High Potash Fertilizer	14, 74
Potato Fertilizer	14, 74
Tobacco Grower, Vegetable Formula	14, 74
F. S. Royster Guano Company, 602 Citizens Nat'l Bank Bldg., Baltimore, Md.:	
Cottonseed Meal	3, 15
Nitrate of Soda	15, 18, 20
Royster's 16% Acid Phosphate (See Superphosphate)	15, 38
5% Truck Guano	15, 74
Gem Guano	15, 74
Ground Dried Fish Scrap	15, 48, 49
Pure Raw Bone Meal	15
Quality Trucker	15, 74
Rational Guano	15, 74
Spearhead Guano	15, 74
Top Dresser	15, 74
Trucker's Delight	15, 74
Valley Tobacco Guano	15, 74
Sheep Manure	15, 78, 82
Sulphate of Ammonia	15, 18, 20
Sulphate of Potash	15, 41, 43
Sheep Manure, etc.,	78
analyses of	82, 83

Page

M. L. Shoemaker & Co., Inc., Venango St. & Delaware Ave., Philadelphia, Pa.:
"Swift-Sure" Ammoniated Phos Quick Grower 5-8-7 15
Four and Half Bone Meal 15, 52, 55
Tobacco and General Use (Pot. fr. Sulphate) 3-10-3 .... 15, 74
Tobacco Special 15, 74
Tobacco Starter 4-10-0 15
Springfield Rendering Co., Springfield, Mass.:
Springfield Animal Brand 3-8-4 .... 15, 74
Market Garden Grower and Top Dresser 5-8-7 .... 15, 74
Special Potato, Onion and Vegetable 4-8-4 .... 15, 74
Tobacco Special 5-4-5 15
4-8-7 .... 15, 74
Superphosphate (Acid Phosphate) 37
analyses of 38
Swift & Company Fertilizer Works, Baltimore, Md.:
Vigoro 15
Tankage 52
analyses of 53
I. P. Thomas & Son Company, 1000 Drexel Bldg., Philadelphia, Pa.:
16% Acid Phosphate (See Superphosphate) 15, 38
Economy Fertilizer 3-12-3 .... 15, 74
I. P. Thomas 5-8-7 .... 15, 74
Long Island Special 4-8-7 .... 15, 74
Muriate of Potash 15, 41, 43
Nitrate of Soda 15, 18, 20
Pure Ground Bone 15, 52, 55
Tankage 15, 52, 53
Thomas' Fish and Potash Fertilizer 5-8-5 15
Thomas' Tobacco Grower 5-4-5 .... 15, 76
Tip-Top Super-Phosphate 3-10-6 .... 15, 74
Trucker's High Grade Guano 4-8-4 .... 15, 76
Victor Potash Fertilizer 2-8-5 .... 15, 76
7% Guano 15, 76
Triton Oil and Fertilizer Company, 101 Beekman St., New York City.:
Acid Phosphate (See Superphosphate) 15, 38
Nitrate of Soda 15, 18, 20
Triton 4-8-4 Fertilizer 15, 76
Triton 4-8-7 Fertilizer 15, 76
United States Guano Co., Baltimore, Md.:
Standard United States 3-9-2 16
4-8-10 .... 16, 76
5-8-5 .... 16, 76
16% Acid Phosphate (See Superphosphate) 16, 38
Bone Meal 16
Ever Green Fish Guano 16
Mammoth Potato Grower 16, 76
Nitrate of Soda 16, 18, 20
Royal Potato Grower 16, 76
Urea, analyses of 21
Virginia-Carolina Chemical Corporation, 120 Broadway, New York City.:
V-C Aroostook Potato Grower 16, 76
Fairway Fertilizer 16, 76
XXXX Fish and Potash 16, 76

	Page
Wilcox Fertilizer Company, Mystic, Conn.:	
Acid Phosphate (See Superphosphate)	16, 38
Ground Blood and Meat Tankage	16, 53
Ground Steamed Bone	16, 55
Nitrate of Soda, containing Potash	16, 47
Wilcox Corn Special	16, 76
Dry Ground Fish	16, 49
General Vegetable Phosphate	16, 76
High Grade Fish and Potash	16, 76
Potato Fertilizer	16, 76
Special 4-8-4 Fertilizer	16, 76
7-6-5 Top Dresser	16, 76
Wood Ashes	12, 41
analyses of	45
Worcester Rendering Co., Auburn, Mass.:	
Prosperity Brand Complete Dressing	16, 76
Corn and Grain Fertilizer	16, 76
Market Garden Fertilizer	16, 76
Potato and Vegetable Fertilizer	16, 76
S. D. Woodruff & Sons, Orange, Conn.:	
"Toro" Brand of Sheep Manure	16, 78, 82
Woodruff's Home Mixed Fertilizer	16, 76
Wm. P. Young & Son, 22-24 High St., Pottstown, Pa.:	
Young's Formula A Complete Fertilizer	16, 76

BULLETIN 291 DECEMBER, 1927

Connecticut Agricultural Experiment Station

New Haven, Connecticut

REPORT OF THE DIRECTOR

FOR THE

YEAR ENDING OCTOBER 31, 1927

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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as of

October 31, 1927

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QUINNIPIACK PRESS, INC., NEW HAVEN

REPORT OF THE DIRECTOR

For the Year Ending October 31, 1927.

To the Board of Control of the Connecticut Agricultural Experiment Station:

The year covered by this report is the fifty-second in the history of the Station—a half century that has seen the United States grow in population from 44 million to 110 million, the number of farms increase from less than four million to over six million, and the area under cultivation more than double. Changes of far-reaching and fundamental influence have been wrought in our whole economic and social structure.

Fifty years ago in the vast territory west of the Mississippi there were still unconquered tribes of Indians, herds of wild buffalo and millions of acres of cheap land, the too rapid settling of which brought disaster not only to the farmer but to the nation as a whole. There was no telephone, no automobile, the radio was undreamed of and the railroads were just beginning to reach out into the great central grain and cattle country. In 1875 the reaper was a relatively new tool; last season in a single day, a Kansas farmer and his son harvested and threshed 100 acres of wheat with a "combine." In Connecticut we were growing our own fresh beef, mutton and pork—the first refrigerator car reached New York in 1879. Creameries manufacturing butter and cheese were to be found in almost every town in the State. A few far-seeing men had sensed the changes that were to come, and many more had only a vague feeling of uneasiness—they saw cheap grain, wool, meat and butter flooding New England, and some predicted the everlasting ruin of our New England agriculture.

Out of this was born the Experiment Station Idea, not to stay the hand of change and progress but to discover the fundamental laws of plant and animal life upon which the new agriculture was to be built—an agriculture that in Connecticut has discarded unprofitable fields, crops and flocks, but which today produces over twice the *actual* wealth of 1875.

To enumerate all of the Station's contributions to this process of evolution would be tedious. Some of the most outstanding are: the discovery of the cause of potato scab; the introduction of spraying to control plant pests; the study of the chemistry of the vegetable proteins which led to discovery of the vitamines and a knowledge of the food value of milk and other farm products; the introduction of shade for tobacco growing; bulk fermentation of tobacco; better methods of fertilizing this important crop; a new method of corn breeding which has completely changed our methods of improving this cereal.

During all these years the Station has continued its important "defense" work, annually collecting and analyzing thousands of samples of fertilizers, feeds, foods and drugs; has inspected the orchards and nurseries and kept down the toll of insect and fungous damage. But the two-fold function of the Station was recognized from the beginning, for while the first director believed thoroughly in performing the direct services of control and education, he wrote in his first report, "the Experiment Station will be worthy the name in proportion as it carries on accurate and thorough investigations in agricultural science."

FIG. 1.—The Station Agent drawing a sample of fertilizer.

REVIEW OF THE YEAR

During the year under review, the work in all departments has gone forward without interruption and with gratifying results. It is a particular pleasure to here acknowledge the debt of the Station, and especially that of the director, to Dr. E. H. Jenkins, Director Emeritus, for his constant interest and wise counsel.

CONTROL AND INSPECTION WORK

INSPECTION OF FERTILIZERS, FEEDS, FOODS, DRUGS, ETC.

In accordance with the statutes assigning these duties to the Station, the Chemical Laboratory has examined during the year 884 samples of fertilizer, lime and similar materials, of which 507

were drawn officially by the Station Agent and the balance received from farmers. The annual report on fertilizers was issued as usual in December.

Under the new feeding stuffs law, which went into effect July 1, 1925, all "Commercial Feeding Stuffs" offered for sale must be licensed. For the year 1927, 177 firms registered 793 brands. For the inspection of these, 670 official samples were drawn, which with other samples received required 898 complete analyses.

As usual much time was consumed in the analysis of foods and drugs, the samples being collected by the State Dairy and Food

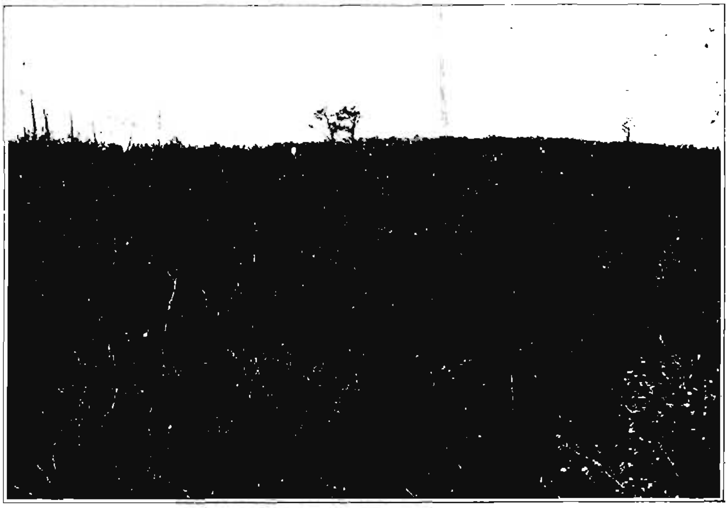

FIG. 2.—Part of a large area, outside of Connecticut, completely defoliated by the Gipsy Moth—photograph taken July 15. Courtesy of Dr. A. F. Burgess, U. S. D. A.

Commissioner and also by the Station Agent. Reports on 1100 food products and 150 drug products were published in Bulletins 286 and 287 respectively.

In addition to the above the laboratory calibrated 3100 pieces of Babcock glassware, examined Insecticides and Fungicides offered for sale in the state and made a large number of miscellaneous analyses, including several submitted by the newly-created State Water Commission.

CONTROL OF INSECT PESTS

The problems of insect and disease control are becoming more and more difficult each year as new pests appear in the State. The campaign against the *Asiatic Beetle*, which was discovered two

years ago in the city of New Haven, has been carried on vigorously. During the past year lawns in a large area in the Westville district were again treated with Carbon Disulphide Emulsion and very encouraging results obtained. In addition, a strict quarantine on the moving of soil from this area was enforced. Studies of the Asiatic Beetle indicate that it probably will never be a serious pest in this climate, and the treatment, above mentioned, offers an effective control against damage to lawns.

The *Japanese Beetle* has spread from the region of Philadelphia into New York and southwestern Connecticut. Cooperating with the United States Department of Agriculture, the Station enforced

FIG. 3.—Anti-mosquito Work—cleaning out an old ditch.

a quarantine on farm products and plants bearing soil as shipped out of the New York metropolitan district. This required a twenty-four-hour patrol on the Boston Post Road near Stamford as well as on other roads in this region. The quarantined area now includes most of Fairfield County and will require continued inspection, scouting and patrolling.

As usual members of the Station staff inspected all *nurseries* in the State and issued permits for the importation and shipment of nursery stock. Here again there is a steady increase in the amount of service required.

In the control of the *Gipsy Moth* we have continued to wage a successful battle. By intensive scouting, spraying and destruction of egg clusters it has been possible to prevent any injury within

the borders of the State. In adjoining states, where funds were not available, serious damage occurred during 1927.

The *European Corn Borer* has continued to be a constant threat since its introduction into the State some five years ago. However, the number of infestations discovered each year has been small, never numbering over six. All corn stalks and weeds have been destroyed in the neighborhood of each infestation found, thus undoubtedly preventing the serious spread of this insect. The cordial cooperation of the United States Department of Agriculture has greatly aided in all of our work.

While the State appropriation for the *elimination of mosquitoes* was not increased it was possible to arouse a very lively interest

FIG. 4.—Station crew eradicating wild Ribes from pine land.

in New Haven and the surrounding towns with the result that the several Chambers of Commerce undertook the raising of a fund of $40,000 for completing the drainage work in this district. Results have been very encouraging and the plans now call for commencement of operations in the spring of 1928.

In addition to the above, all apiaries in the State were inspected for European Foul Brood, many orchards and gardens were visited and general assistance rendered in the control of insect pests.

WHITE PINE BLISTER RUST

During the season of 1927, 159,121 wild Ribes and 2,235 cultivated Ribes were destroyed on 20,904 acres. The work was carried on in 16 towns. 10,400 acres of white pine were protected.

In addition 20,100 acres of non-pine land were eliminated in the general pine region. Approximately 1,000 acres of land adjoining 10 commercial nurseries were freed from Ribes as a preliminary step in an effort to secure a modification of the Federal quarantine on white pine shipments out of the state. The nurserymen cooperated with us in this sanitation work.

All eradication this year represents cooperative effort on the part of the state and towns, individuals and nurseries.

Experimental work was conducted to study some of the factors that make up crew efficiency.

Comparative figures for the last three years are given below:

Year.	Initial eradication Acres.	Re-eradication Acres.	Total eradication Acres.	Wild Ribes Pulled.	Cultivated Ribes Pulled.	Area pine protected Acres.	Nursery sanitation Acres.
1925.......	6,688	40	6,728	258,515	684	?	0
1926.......	21,687	570	22,256	182,826	330	7,400	0
1927.......	12,068	8,836	20,904	159,121	2,235	10,400	1,000

The drop in acres eradicated in 1927 from that in 1926 is due to the fact that more time was devoted to experimental and sanitation work, and to the scattered location of the eradication areas.

SEED TESTING

The total number of seed samples tested during the year, November 1, 1926, to November 1, 1927, was 416. These were from 73 sources and comprised 43 different species of plants.

Last year a special inspection was made of vegetable seed sold in packets and reported in Bulletin No. 283. This year the study was confined to bulk seed obtained chiefly from the market gardeners. Only fair germination was obtained.

Progress of Investigations

BIOCHEMISTRY

The Chemistry of the Proteins. Much time has been devoted to a revision of the standard procedure for the separation of histidine from arginine, as these two basic amino acids not only appear to form an important part of the base fraction from yeast but are also found in many other materials. A method has been developed which is much simpler and more expeditious than that formerly employed and is practically quantitative.

The great difficulty in dealing with yeast and other extracts has been the selection of a method for separating the bases from other substances which form insoluble precipitates with phosphotungstic acid. This reagent has been widely employed upon the assumption that the nitrogen precipitated by it belonged to bases. The presence of peptides in extracts of plant material renders this

assumption unwarranted, and attempts to isolate derivatives of basic substances gave results which fall far short of those to be expected from their nitrogen content. Until methods are developed whereby peptides can be quantitatively removed, further progress in the analysis can only be made by hydrolysis of the peptides to their constituents of amino acids before the precipitation of the bases. Papers on these phases have been published in the Journal of Biological Chemistry and the Journal of Plant Physiology.

Experiments in Nutrition. The investigations on the rate of growth have been continued as a major study. As reported last

FIG. 5.—Two rats from the same litter. Age 79 days.
Left—Diet, standard. Weight, 160 gms.
Right—Diet, high protein + alfalfa and liver. Weight, 301 gms.

year, growth at a rate of three times the average rate was secured with a number of animals. Subsequent experiments have confirmed this, not only with casein furnishing the protein but also with rations containing edestin, lactalbumin and cottonseed globulin. Liver, lettuce and yeast added to rations previously considered sufficient have all produced these results, but there are indications that a combination of two of these is more effective. Fresh alfalfa leaves, in daily quantities that compare favorably with lettuce, have proved to be notably potent. Studies dealing with the effect of high protein diets upon various physiological functions have been continued and a report published; also the effect of diet on the reproductive organs and the construction of bone.

BOTANY

Mosaic. The year 1927 has been the most favorable one we have known for some time for the development and spread of mosaic troubles of all susceptible hosts. This was because of the favorable weather and abundance of insect carriers, especially lice. Over-winter weed-carriers were observed in some cases in the vicinity of fields of infected cultivated plants.

The chief new observation along microscopical lines was the finding, in a certain type of mosaic sent us by Dr. Valleau of Kentucky, of definite inclusions in the nucleus of infected cells. These were similar to the common "plate crystals" found in the cell outside.

In 1926 a most interesting discovery was the fact that tobacco leaves dried and preserved in the herbarium for 24 years, still

FIG. 6.—Effect of Mosaic on Summer Squash.

carry the active principle and could be used to infect living plants with the mosaic disease. Infection experiments continued this year with old dried leaves and preserved juice gave similar results.

Experiments with New Seed Disinfectants for Potatoes. The results of our experiments with the three fungicides tried, Semesan, Formalin and Mercuric Chloride, showed no positive stimulating effects for any of them over the check as regards earliness of first vines to appear, earliness of vines as a whole, size or vigor of the vines, or increased yields of tubers. The experiments were carried on in triplicate with two varieties of potatoes.

Spraying and Dusting of Apples. The results from the several treatments on the orchard of F. N. Platt, Milford, in 1927 were not as good as for the past few years. This was due to the excessive rainfall during the latter part of the season which caused an unusual development of fungous diseases, especially apple scab infection late in the season.

Five different treatments were used: complete spray schedule, complete dust schedule with each of two dusts, Pomodust and Kolodust; and two combinations of dust and spray. Contrary to the usual performance of these materials the Kolodust gave the best control of scab, with Pomodust second and spray third. We find this was doubtless due to the fact that the calyx treatment of dust was put on immediately before a three day rain period during which the maximum discharge of scab spores took place, while the spray was not put on until after this period.

Spraying gave considerably better control of sooty blotch and fruit speck than did the dust.

FIG. 7.—Scoring Apples in the Spraying and Dusting Experiments at the F. N. Platt orchard.

ENTOMOLOGY

Further investigations have been conducted on the life history, habits and control of the *Oriental peach moth.* Considerable data have been obtained from field cages and bait pans placed in the orchard. Three broods were evident, the same as in 1926. Considerable work has also been done towards developing a substitute for arsenical sprays which promise to be less toxic to human beings and cause less injury to peach foliage. Thus far, sprays have not been effective in controlling the insect. One parasite, *Macrocentrus ancylivora* Rohwer, was reared in considerable numbers the past season from one orchard, and work is also in progress in

the artificial breeding of an egg parasite, *Trichogramma minutum* Riley, which infests the eggs of the Oriental peach moth in Connecticut.

The study of the *Plum Curculio on apple* has been continued as a part of the five-year program on this subject. During the year, jarring records have been kept and field tests continued with sprays applied at different times, and with fish oil as a sticker with a view to eliminating some of the sprays.

The studies of the life history, habits, and distribution of the *Asiatic beetle,* begun in 1926, have been continued and nearly completed. These include many temperature records and the effect of temperature on the development of the grubs in the soil. Experiments have also been made in treating soil with lead arsenate and other materials before seeding, in order to render the lawn grub-proof.

The life history and habits of the *Imported Birch Leaf Miner,* are being investigated, and the length of the various stages of the life cycle have been determined. The number of generations is probably three, but another season's work is necessary to settle this point. Several insecticides have been tried as a means of control, but so far none has proved satisfactory.

FORESTRY

Under the Clark-McNary Act 194,000 trees were distributed to private owners and 445,000 under the usual Station plan which has been in force for a number of years and whereby farmers pay all costs except overhead.

The investigation of *soil as a site factor* has continued to be the major research problem. In 1926 and 1927 a very thorough study was made of two tracts. The soils were carefully mapped and the forest vegetation listed and measured. No significant correlations have resulted. It will be necessary to test this method on forests of known history which is now being done on pine plantations. In 1927 a very careful study was made of the lesser vegetation in several tracts in an attempt to establish indicator plants or groups of plants. The tentative conclusion reached is that the history of the stand has greater influence on the lesser vegetation than the soil type.

PLANT BREEDING

A sterile tassel character in white flint corn has been found to be controlled by an inherited factor linked with the factor for white seed color. The possibilities of using this character in the production of crossed corn seed are being investigated. By backcrossing, this character is being transferred to several different types of sweet corn and field corn.

Inbred strains in the twentieth generation of self-fertilization have been separated into two strains in each line and are being continued for another period of continuous inbreeding to determine their fixity and trueness to type and the effects of long continued inbreeding.

Thirteen crosses of inbred strains of Evergreen sweet corn have been selected out of nearly 200 crosses as promising for canning purposes. These are being tested further.

A large number of self-fertilized lines of early yellow sweet corn are being selected for the purpose of producing a desirable market garden type.

FIG. 8.—Red Leaved White Evergreen, a cross of inbred strains of Sweet Corn. Note uniform earing.

A method of combining a number of inbred strains of field corn and crossing two such combinations, called "multiple crossing," is being tried out to simplify the production of crossed seed corn on a large scale.

Inbreeding and selection are also being applied to some of the naturally cross-fertilized vegetables. It has been found that about 15 per cent of carrot plants set seed from their own pollen. Onions and beets are being self-fertilized for the first time this year. A number of self-fertilized lines of black raspberries are in their second generation and of strawberries in the second generation. Both series are showing many important differences. The strawberries have notably declined in vigor and productiveness and therefore will presumably give the same response to crossing as corn.

LIBRARY

Several selections of a cross of Cuban and Broadleaf tobacco have been backcrossed to Cuban from one to four times. The number of generations of backcrossing to restore the main type of one of the parents while retaining a few of the most valuable characters of the other parent is being determined.

Pure line selections are also being made in tobacco, lettuce, lima beans and peppers to find out possibilities for improvement by this method.

SOILS

In the attempt to identify all of the soils of the state 51 different series have been classified. When these are divided into

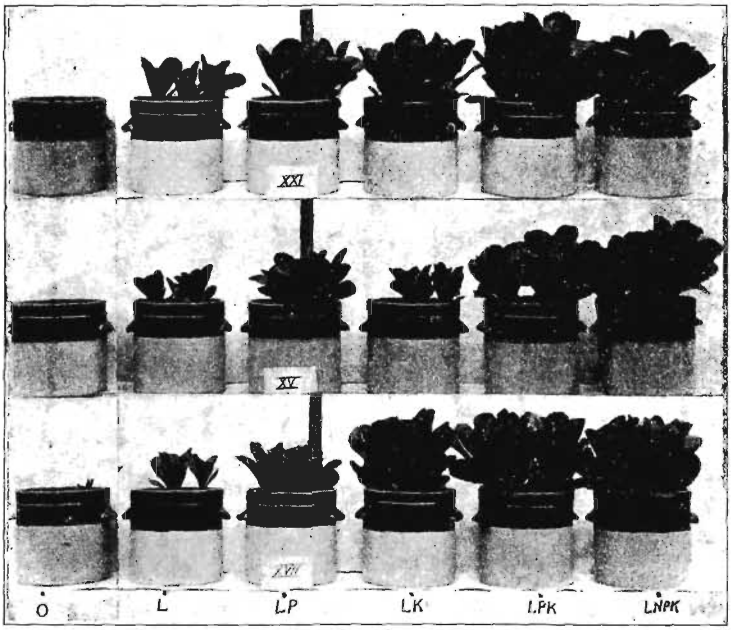

FIG. 9.—Crops Vary in their Fertilizer Requirements on Different Soils. Growth of lettuce on three different soils with treatments as follows:

O—Nothing.
L—Lime.
LP—Lime and Phosphorus.
LK—Lime and Potassium.
LPK—Lime, Phosphorus and Potassium.
LNPK—Lime, Nitrogen, Phosphorus and Potassium.

On Soil XXI there is an almost equal response to Phosphorus and Potassium. On Soil XV there is a marked response to Phosphorus, but a slight response to Potassium until Phosphorus has been applied. Soil XVII shows only slight response to Phosphorus but very large benefits from Potassium.

types we find over 150 distinct soils represented in Connecticut. The major problem has been to devise a workable agronomic classification of these many types, which are taxionomically different. Some progress can be definitely reported. The 51 soil series can be divided into 10 major groups, which with some sub-grouping make 15 in all. A key has been worked out for the use of county agents or other workers.

Greenhouse studies were conducted on 22 soils representing 12 distinct types. All but three show a marked response to lime. Potash produced some increase on all but two soils, but on five only was it as valuable as phosphorus.

An outgrowth of the laboratory studies was the discovery that old tobacco soils are very high in available phosphorus and as this was confirmed by field tests at the Tobacco Station, farmers have been advised that phosphorus applications may be reduced in such cases. (Tobacco Bulletin No. 7).

TOBACCO SUB-STATION

The fertilizer experiments, coupled with the studies of the soil department, have shown definitely that old tobacco soils do not respond to applications of phosphoric acid in any form. It appears that there are large accumulations in available form in these fields and growers may therefore omit or greatly reduce the application of phosphoric acid which is usually in the form of precipitated bone.

On the extensive *"source of potash"* plots, carbonate of potash has so far given the best quality of leaf. Double manure salts are of no advantage over sulfate of potash.

During the last two years over 1,500 tobacco soil samples have been tested for *acidity*. All cases of Black Root rot have fallen above 5.6 pH, the worst being above 6.0 pH. (Tobacco Bulletin No. 8).

In cooperation with the Bureau of Chemistry, U. S. D. A., we have tested *shade cloth treated in various ways to increase its life*. Untreated cloth loses 47% in strength in one season, while treated cloth lost but 5%. Thus, it would seem that the treatment makes possible a second season for the cloth which is usually discarded after one season. Cloth costs $150 to $200 per acre. Treatment adds 15% only to this cost. The process therefore should effect very material savings. From the standpoint of the yield and quality of the tobacco the yellow, treated cloth is just as satisfactory as the untreated.

In the *topping and suckering experiments* the best results have been obtained when plants are topped four leaves below the first bald sucker, at the time of the opening of the first flowers. Removing suckers twice seems to give the optimum results.

Field Days and Exhibits

Since the purchase of the Mt. Carmel Farm in 1911, no field day had been held on the Station grounds on Huntington Street, the farm being considered a more suitable place. This year it was decided to set aside June 3rd as a special day for inspection of the work being conducted in the laboratories and greenhouses. The Connecticut Dairymen's Association voted to make this their summer meeting and special attention was given to a discussion of alfalfa as a crop for dairy farms. Mr. J. S. Owens and Mr. Raymond Clapp of the Extension Service gave us excellent co-operation. The address by Dr. G. F. Warren of the Cornell College of Agriculture was particularly well received.

The Annual Field Day at the Tobacco Station in Windsor was held on August 2nd with a large attendance. Dr. H. J. Wheeler gave the principal address.

Fig. 10.—Tobacco Exhibit at the Connecticut State Fair—September, 1927.

One of the most successful and attractive exhibits ever shown by the Station was that prepared for the New Haven Progress Exposition held in February, 1927. Five large wall panels were used to illustrate the principal agricultural industries of Connecticut—Dairy, Poultry, Vegetables, Tobacco, Fruit and Forestry. Before these on tables were arranged material showing how the Station serves each of these enterprises.

For the Connecticut State Fair in September this same exhibit was shown, and attracted much attention.

Changes in the Station Staff

Appointments:

W. R. Singleton, S.M., Assistant Geneticist, March, 1927.
H. J. Lutz, M.F., Assistant Forester on Purnell Project, June, 1927.
T. R. Swanback, B.S., Scientific Assistant at Tobacco Station in Windsor, June, 1927.
G. P. Zundel, M.S., Assistant in Botany, July, 1927.
J. P. Johnson, B.S., Deputy in Charge of Asiatic and Japanese Beetle Quarantine, July, 1927.
David S. Walden, B.S., Assistant Chemist, August, 1927.

Resignations:

P. C. Mangelsdorf, S.D., Assistant Geneticist, January, 1927.
Willis R. Hunt, Ph.D., Scientific Assistant in Botany, July, 1927.

Physical Equipment

Additions to the Station's scientific equipment included a Spencer Binocular Microscope for plant pathological work, a Bausch and Lomb Petrographic Microscope for soils investigations, a High Pressure Autoclave for hydrolysis of proteins, a Lovibond Tintometer, a Saybolt Viscosimeter, an electric refrigerator, and a Leitz Research Microscope for cytological studies in plant breeding.

Additions to the library of permanent value were 900. Of these, 100 were bound books and the balance journals and the like which are bound by the Station. The total number of volumes on October 31, 1927, was 16,600.

PROJECTS ACTIVE DURING THE YEAR

Analytical Chemistry

Dr. E. M. Bailey in charge

1. Inspection of Fertilizers.
2. Inspection of Feeding Stuffs.
3. Inspection of Foods and Drugs.
4. Calibration of Babcock Glassware.
5. Inspection of Insecticides and Fungicides.
7. Analysis of Diabetic Foods.

Biochemistry

Dr. T. B. Osborne in charge
(In Collaboration with Dr. L. B. Mendel, Yale University)

I. Nitrogenous Constituents of Plants.
  1. (a) The nature of the simpler nitrogenous constituents of yeast.

(b) The protein and non-protein nitrogenous constituents of the tobacco leaf.

2. (a) Possible means of improvement in the methods for the determination of basic amino acids of proteins.

(b) Methods for the preparation of pure proteins on the large scale necessary for obtaining material for chemical and nutritional studies.

II. Nutrition Investigations.

1. Certain factors in the diet which appear to be responsible for extraordinarily rapid growth.
2. The relation of diet to opthalmia.
3. The relation of diet to fertility in cooperation with Dr. Mason of Vanderbilt University.

Botany

Dr. G. P. Clinton in charge

1. The Effect of Fertilizers, Especially Nitrate of Soda, on the Growth, Yield, Longevity and Yellows of Peaches.
   (*Terminated during this year*).
2. The Nature and Cause of Mosaic Disease of Plants.
4. The Rusts of Connecticut.
5. Plant Disease Survey of Connecticut.
6. *Thielavia Basicola,* a Study of the Perfect Stage.
7. A Study of *Pythiums.*
8. Comparison of Spraying and Dusting on Apples and Peaches.
9. Control of Celery Blights with Sprays and Dusts.
   (*Terminated during this year*).
13. Peach "Yellows."
15. Chestnut Blight—virulence studies.
21. Influence of Bud Inheritance on Yield of Peaches.
   (*Terminated during this year*).
22. Influence of Root Grafts on Scions of Apples.
   (*Terminated during this year*).

Entomology

Dr. W. E. Britton in Charge

1. The Life History, Habits and Control of the Plum Curculio on Apple.
2. Comparisons of Spraying and Dusting on Apples and Peaches. (See Botany).
6. Control of Foul Brood of Bees.
7. A Study of the Asiatic Beetle, *Anomala orientalis.*
9. Insect Survey of Connecticut.
14. A Study of the Chemical Changes in Standard Spray Mixtures.
15. Bionomics of the Birch Leaf Skeletonizer, *Bucculatrix canadensisella.*
16. Experiments with Baits Attractive to the Cabbage Maggot Fly.
17. Life History and Methods of Controlling the Oriental Peach Moth, *Laspeyresia molesta.*
18. Life History of Imported Current Worm.
20. Life History, Habits and Control of the Imported Birch Leaf-Miner, *Fenusa pumila.*
21. Life History and Control of the Spinach Leaf-Miner.
22. Insects Infesting Nursery Stock in Connecticut.
23. Spraying to Control the Spruce Gall Aphid.

Control Projects

10. Inspection of Orchards and Nurseries.
11. Control of Gipsy Moth.
12. Elimination of the Mosquito Nuisance in Salt Marshes.
13. Inspection of Apiaries.
19. Control of the European Corn Borer.
24. Control of the Asiatic Beetle.

Forestry

Mr. W. O. Filley in charge

1. Experimental Plantations on a Sandy Tract at Rainbow.
   a. Comparison of a wide variety of conifers and hard woods.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of Thinning in White Pine (At Shaker Station)—Three Grades of Thinning.
3. Effect of Thinning in Hard woods (At Quassipaug Lake).
8. Studies of Forest Plantations (State-wide).
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. Distribution and Growth of Forest Trees as Influenced by Soil Conditions.
   a. To determine the basic factors inherent in forest soils which influence the natural growth and distribution of trees.
   b. To study the natural distribution of tree species and forest types with reference to soil.
   c. To study the growth and yield of forests as influenced by soil factors.
11. Coniferous Seed Bed Study to Determine:
   a. The value of fertilizers in seed beds.
   b. The value of different amounts of seed.
   c. The value of Dusts and Sprays in preventing damping off.

Control Project

7. Control of White Pine Blister Rust.

Genetics (Plant Breeding)

Dr. D. F. Jones in charge

1. A Genetic Study of Hereditary Characters in Corn Involving Their Linkage Relations and Variability.
2. The Effects of Inbreeding and Crossing Upon Corn in Relation to Vigor, Rate of Growth, Productiveness and Variability.
3. Methods for the Improvement of Naturally Cross-Fertilized Plants by Selection in Self-Fertilized Lines—with Particular attention to the Monoecious, Wind-Pollinated Corn Plant.
4. Methods for the Improvement of Naturally Self-Fertilized Plants—with Particular Attention to Tobacco.

Soils

Mr. M. F. Morgan in charge

1. What Soil Characters are Factors in Determining the Agronomic Value or Utilization of Land?
2. Experiments in Lawn Fertilization.

Tobacco Sub-Station at Windsor

Dr. P. J. Anderson in charge

1. Fertilizer Experiments on Yield and Quality.
   a. Sources of Nitrogen.
   b. Rates of Phosphoric Acid.
   c. Sources and Rates of Potash.
   d. Fractional applications.
   e. Stable Manure.
2. Strain Tests of Havana and Broadleaf.
3. Improvement of "Cuban" Shade Tobacco.
4. Effect of Cover Crops.
5. Brown Root Rot (Tobacco Sick Soils) with U. S. D. A.
6. Black Root Rot—relation of soil reaction.
7. Trials of Cigarette Types of Tobacco.
9. Tests of Chemically Treated Shade Cloth—with U. S. D. A.
10. Role of Humidity and Temperature in Curing.
11. Role of Nitrogen and Sulfur in the Metabalism of the Tobacco Plant.
12. Topping and Suckering—the effects at different Heights and Dates.
13. The Effect of Fertilizers (Acid or Alkaline Residues) on Black Root Rot.
14. Control of Wire Worms in Tobacco.

PUBLICATIONS

Bulletins

No. 282. Fertilizer Report for 1926.
No. 283. The Quality of Vegetable Seed Sold in Packets in Connecticut.
No. 284. Index to Reports on Food Products and Drugs, 1915-1925.
No. 285. Report of the State and Station Entomologist.
No. 286. Report on Food Products and Drugs, Part I.
No. 287. Report on Food Products and Drugs, Part II.
No. 288. The Biology of the Birch Leaf Skeletonizer.
No. 289. Report on Commercial Feeding Stuffs.

Tobacco Series

No. 7. Phosphorus on Tobacco Soils.
No. 8. Report of the Tobacco Station at Windsor (1926).

Circulars of Immediate Information

No. 55. Asiatic Beetle Quarantine.
No. 56. Japanese Beetle Quarantine.
No. 57. Regulations Concerning the Transportation of Nursery Stock in the United States and Canada.
No. 58. Japanese Beetle Quarantine (Revised).
No. 59. European Corn Borer Quarantine (Revised).
No. 60. Revision of Feed Regulations.

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Report on Cacao Products.
E. M. Bailey. Jour. Assoc. Official Agr. Chemists, 9, 4, 461, 1926.
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George Richards Lyman (Biography of).
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Entomology

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R. C. Botsford. Proceedings 14th Annual Meeting of the New Jersey Mosquito Extermination Assoc., p. 115, June, 1927.

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WHAT THE STATION CAN DO

Each mail brings to the station requests for information and service, the range of subjects being almost without limit. Every effort is made to comply with these requests, even though they are outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like and again we are asked to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we can furnish information and the kinds of samples we can accept.

The Station can furnish information on:

Fertilizers and fertilization.
Soils and their management.
The chemical composition of Foods, Drugs, Insecticides and Fungicides.
The composition of Diabetic Foods.
Insect Pests of plants and their control.
Fungus and other Diseases of plants and their control.
Sprays and spraying.
Fruits and fruit management.
Weeds and their control.
Forestry—all phases.
Care of Shade Trees.
Plant breeding—especially field and sweet corn.
Lawns, establishment and care.
Bees.
Mosquito Elimination.
Tobacco culture.

Samples and specimens that can be analyzed, tested or identified:

Fertilizers.
Feeding stuffs.
Foods and Drugs.
Milk—except for bacterial count.
Seeds.
Weeds and other plants.
Insects.
Diseased and injured plants.
Soils.

The Station cannot furnish information on:

Live stock feeding and management, including Poultry.
Animal diseases.
Household management.
Clothing.
Farm management.
Marketing and coöperation.

Requests for information on these subjects should be sent to the Connecticut Agricultural College at Storrs.

The Station cannot make analyses and examinations of:

Drinking water—apply to the State Board of Health, Hartford.
Milk for bacterial content—apply to the Dairy Commissioner, Hartford.
Sick or dead poultry should be sent to Poultry Department, Storrs Experiment Station, Storrs, Conn.

All of which is respectfully submitted.

WILLIAM L. SLATE,
Director.

BULLETIN 292 DECEMBER, 1927

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Some Insect Pests of Nursery Stock in Connecticut

W. E. BRITTON and M. P. ZAPPE

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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CONTENTS

	PAGE
GENERAL FEEDERS	119
Leopard Moth	120
Fall Webworm	120
Cankerworms	120
Tussock Moths	121
Gipsy Moth	122
European Fruit Lecanium	123
Oyster-shell Scale	123
INSECTS INJURING FRUIT STOCK	124
Eastern Tent Caterpillar	125
Apple and Thorn Skeletonizer	126
Red-humped Caterpillar	126
Yellow-necked Caterpillar	127
Japanese Beetle	127
Rose Chafer	128
Pear Slug	129
Imported Currant Worm	129
Climbing Cutworms	130
New York Weevil	131
Apple Tree Borers	131
Oriental Peach Moth	132
Peach Borer	132
Shot-hole Borer	133
Imported Currant Borer	134
Green Apple Aphid	134
Woolly Apple Aphid	135
Black Cherry Aphid	136
Currant Aphids	136
San José Scale	137
Scurfy Scale	137
Leaf Hoppers on Apple	138
Tarnished Plant Bug	139
Pear Leaf Blister Mite	140
European Red Mite	140
INSECTS INJURING DECIDUOUS SHADE AND FOREST TREES	141
Larch Case Bearer	142
Locust Leaf Miner	143
Imported Birch Leaf Miner	143
Birch Skeletonizer	144
Elm Leaf Beetle	144
Willow Flea Beetle	145
Imported Willow Leaf Beetle	145
Cottonwood Leaf Beetle	145

Spotted Willow Leaf Beetle 145
Poplar Tent Maker 146
Larch Sawfly 146
Bronze Birch Borer 147
Linden Borer 148
Locust Borer 148
Poplar and Willow Borer 149
Mites 150
Green Aphids 150
Beech Woolly Aphid 151
Willow Aphids 151
Oak Gall Scale 151
Pit-making Oak Scale 151
Tulip Tree Scale 152
Terrapin Scale 152
European Elm Scale 153
Cottony Maple Scale 153
Elm Scurfy Scale 154

INSECTS INJURING SHRUBS AND VINES 154
Io Caterpillar 155
Saddle-back Caterpillar 155
Sphinx Caterpillars or Horn Worms 156
Pipe-vine Caterpillar 156
Cecropia Caterpillar 156
Eight-spotted Forester 157
Rose Sawflies 157
Honeysuckle Sawflies 158
Lilac Borer 158
Rose Stem Girdler 158
Grape-vine Tomato Gall 158
Eriophyid Mites 159
Euonymus Scale 159
Rose Scale 159
White Peach Scale 159

INSECT PESTS OF EVERGREEN TREES AND SHRUBS 160
Pine Sawflies 161
Juniper Webworm 161
Arborvitae Leaf-Miner 161
Boxwood Leaf-Miner 162
European Pine Shoot Moth 162
Spruce Budworm 162
Pales Weevil 163
Otiorhynchid Weevils 163
White Grubs 164
White Pine Weevil 164
Rhododendron Borer 165
Spruce Gall Aphids 165
Pine Bark Aphid 166
Pine Leaf Scale 166

Juniper Scale 167
Rhododendron Lace Bug 167
Spruce Mite 167

INSECTS INJURING PERENNIAL PLANTS 168
Columbine Leaf-Miner 168
Garden Spring-Tail 169
Cutworms 169
Garden Slugs 170
Stalk Borer 170
Iris Root Borer 171
Cyclamen Mite 172
Four-lined Plant-Bug 172

Some Insect Pests of Nursery Stock in Connecticut

W. E. Britton and M. P. Zappe

Just about thirty years ago, the first nursery inspections were made in Connecticut at the request of nurserymen, so that they could advertise their stock as having been officially inspected. In 1901, the General Assembly passed a law establishing the office of State Entomologist and providing for the annual inspection of nurseries. Thus for twenty-seven years all nurseries have been inspected each year as required by law, and records are available showing the various insects found on the many species and varieties of fruit, shade, forest, and ornamental stock. The more important insect pests are treated in this bulletin for the guidance of nurserymen and plant growers throughout the State.

For convenience in identifying nursery insects, brief keys are arranged under each of the following classes: General Feeders; Insects Injuring Fruit Stock; Shade and Forest Trees; Shrubs and Vines; Evergreens; Perennials.

Following the account of each insect in most cases, one or two references are given where more complete information may be found, mostly reports and bulletins of this Station and of the United States Department of Agriculture.

GENERAL FEEDERS

Key

1. Chewing caterpillars devouring the tissues 2
   Scale insects on bark, sucking the sap 6
2. Feeding upon the leaves 3
   Boring in the wood ....Leopard Moth, p. 120
3. Making no conspicuous nest or web 4
   Hairy caterpillars feeding in web at end of branches,
   Fall Webworm, p. 120
4. Caterpillars covered with prominent hairs 5
   Caterpillars smooth, making loop when crawling, Cankerworms, p. 120
5. With black, white, or yellow tufts of hair......Tussock Moths, p. 121
   Gray or brown, without black, white, or yellow tufts; first five pairs of tubercles blue, remaining six pairs red......Gipsy Moth, p. 122
6. Convex hemispherical brown shells...European Fruit Lecanium, p. 123
   Elongated curved shells, nearly the same color as bark,
   Oyster-shell Scale, p. 123

Leopard Moth (*Zeuzera pyrina* Linn.)

The larva of the leopard moth is a borer in the wood of nearly all kinds of deciduous trees and frequently is found in nursery stock—especially in apple trees. It requires two years for its complete development. The adults emerge and the female lays eggs on the bark in July. The young larva tunnels in small twigs, which often break off, and then the borer enters the trunk or larger branches. It pupates in the burrow, from which the adult emerges, leaving the pupa case protruding from the tree. The mature larva is about two inches long and is whitish, with tubercles, head, cervical and anal shields dark brown or black, and is shown on Plate I, d. The adults are a dirty white with semi-transparent wings marked with metallic blue dots and have a wing expanse of about one and three-fourths inches in the male to two and one-half inches in the female. In small nursery trees it is best to destroy the tree or branch infested. In larger trees it is possible to kill the borers with knife or wire, or inject a few drops of carbon disulphide and close the mouth of the tunnel.

(*Bulletin* 169).

Fall Webworm (*Hyphantria cunea* Drury)

All kinds of fruit, shade, and forest deciduous trees and shrubs are subject to the attack of the fall webworm. This insect makes webs or nests on the ends of branches late in summer, and the caterpillars feed inside them. The nests are most noticeable in August and September, though an occasional nest may be seen in June, and a larger number in July. Nests are shown on Plate II, a. There is one generation each year, with a partial second in Connecticut. The earliest nests may produce webworms which develop to the adult stage the same season, and the females lay eggs for the second generation. The adult is a white moth which lays eggs in a compact mass on the under side of a leaf. The young caterpillars make a nest enclosing the leaves on the end of a branch. After devouring the food, they extend the nest to include more leaves. The mature caterpillars are more than an inch long, striped lengthwise with brown and yellow, and covered with brownish hairs.

Trees may be protected by spraying with lead arsenate, and the nests may be destroyed by clipping off and burning them.

(Report for 1917, page 319).

Cankerworms

Cankerworms are small looping caterpillars which feed upon the leaves during May. Some are green and others are dark brown or gray. Two species are involved. The more common one in Con-

necticut is known as the fall cankerworm, *Alsophila pometaria* Harris, because the moths emerge and the females lay their eggs in late fall. These eggs are gray, cylindrical, and laid on the bark in compact clusters of about one hundred eggs arranged side by side and all standing on end. (Shown in Fig. 11 and on Plate I, a, b, c). The other species is called the spring cankerworm, *Paleacrita vernata* Peck, and lays its eggs in loose clusters on the bark in March. These egg-clusters contain an average of about fifty eggs each and are not all arranged on end like those of the fall cankerworm.

The caterpillars of both species appear at the same time and cause the same type of injury to the leaves. They may be distinguished by the fact that the fall cankerworm has a pair of pro-legs on the eighth segment, which are absent in the spring cankerworm.

FIG. 11. Cankerworms.

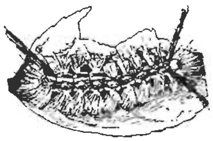


FIG. 12. Larva of the white-marked tussock moth.

Each has a single generation annually. The caterpillars usually become full grown by the first week of June and enter the ground to pupate. The females of both species are without wings and are obliged to crawl up the trunks of trees in order to lay their eggs. The males have wings and are ash-gray in color.

Spraying the foliage with lead arsenate is the remedy.

(Bulletin 1238, U. S. Dept. of Agriculture).

TUSSOCK MOTHS

There are several species of tussock moths, the larvae of which devour the leaves of deciduous trees and shrubs. Perhaps the most important is the white-marked tussock moth, *Hemerocampa leucostigma* S. & A., which has two generations each season. It hibernates in the egg stage as glistening white frothy egg-clusters on the bark of trees. The caterpillars present a very striking appearance, being striped lengthwise with brown and yellow; the head is bright red and there are four tufts of white or buff up-

standing hairs on the back; two forward-reaching pencils of long black hairs are borne near the head and a similar one reaches backward near the tail, as shown in Fig. 12 and on Plate II, c.

The caterpillars feed on the leaves of fruit trees, and shade and forest trees, especially elm, maple, linden, and horsechestnut. The female is wingless and lays its eggs on the old cocoon, as shown on Plate II, f.

The hickory tussock moth, *Halisidota caryae* Harris, has one generation annually, and the caterpillar, shown on Plate II, b, is covered with white hairs marked with black hairs to form a black median line, and two pencils of black hairs at each end of the body. It feeds upon hickory, apple, oak, elm, maple, poplar, linden, and many other trees. The tessellated tussock moth, *H. tessellaris* S. & A., also feeds upon a large number of shade and forest trees, though it is usually less abundant than the hickory or white-marked tussock moths. Its caterpillar resembles *caryae* but has light brown instead of white hairs.

The remedy for all three species is to spray the foliage with lead arsenate.

(Report for 1917, page 325).

Gipsy Moth (*Porthetria dispar* Linn.)

Though not particularly a pest of nursery stock, in seriously infested areas it may be considered as such. There is but one generation each year, the eggs being laid in midsummer and hatching the following spring. The caterpillars feed from birth, about May 1, until fully grown, late in June. They are about two inches in length, hairy, and generally of a brownish or grayish color, sometimes with a distinct median stripe, each side of which there is a row of tubercles or spots. Beginning with the head, the first five pairs of tubercles are bright blue, and the remaining six pairs are a dull brick red.

The pupae are formed in cavities, crotches, on the under side of branches, fence rails, and in other protected situations. From ten to fourteen days are passed in this stage, when the adults emerge. The male is usually a light, grayish-brown moth with a wing-spread of about one and one-half inches, though varying to dark brown. It is a strong flyer and flies during the day. The female has a heavy body and does not fly, is dirty white or buff in color, with wings marked with brownish zigzag cross-bands, as shown in Fig. 13. It has a wing expanse of two inches or more and is usually seen resting on the trunks or branches of trees where the eggs are laid. The eggs are laid in clusters of 200 to 400 each and are covered with hairs from the body of the female parent. These clusters are about an inch long and two-thirds as broad. They

look and feel like a bit of chamois skin. An egg cluster, cocoon, and caterpillar are shown on Plate II, d. and e.

Though the gipsy caterpillars feed upon many kinds of trees, shrubs, and plants, they seem to prefer apple, oak, and willow. Ash is nearly exempt from injury. The remedies are to spray the foliage with lead arsenate in May and June to kill the caterpillars, and to soak the egg-clusters, whenever found, with creosote to prevent hatching.

(Bulletin 186).

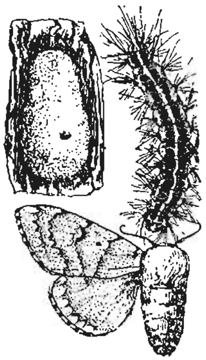


FIG. 13. Gipsy Moth.

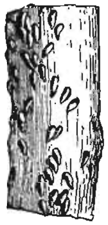


FIG. 14. Oyster-shell scale.

EUROPEAN FRUIT LECANIUM (*Lecanium corni* Bouché—*armeniacum* Craw.)

This European scale has now become one of the most common of all the brown soft scales in the eastern United States. Not only does it attack and injure fruit trees, but also rose, blackberry, ash, chestnut, oak, maple, elm, and linden.

This is a reddish-brown scale, very convex in shape, and the individuals are usually thickly clustered on one side of the stem. Each reaches a diameter of about one-eighth of an inch. The species hibernates on the twigs in a partially grown condition. The young emerge in May and June. (Shown on Plate III, b).

This scale may be killed by dormant sprays of lime-sulphur and miscible oils.

(Report for 1905, page 237).

OYSTER-SHELL SCALE (*Lepidosaphes ulmi* Linn.)

The oyster-shell scale is found on nearly all kinds of deciduous trees and shrubs, and even occasionally on evergreen species like boxwood. It is one of the commonest pests of nursery stock and occurs particularly on apple, ash, birch, lilac, poplar, walnut (*Juglans*), and willow.

The female shells are long and narrow, more or less curved, and about the same color as the bark. They are shown on Plate III, a, and in Fig. 14. Males are less elongate and much smaller.

There is one generation each year, the insect passing the winter in the form of white, oval eggs under the female shells. These eggs are laid in August and September and hatch the latter part of the following May.

All thoroughly infested trees or shrubs or branches thereof should be removed and burned. The remaining portions should be sprayed while dormant with liquid lime-sulphur (1 - 9) or with a miscible oil (1 - 15). Also a spray of 40 per cent nicotine solution (1 - 500) about June 10 will readily kill the young.

(Report for 1903, page 229).

INSECTS INJURING FRUIT STOCK

Key

A. Chewing Insects Devouring Leaves:

1. Forming conspicuous nests or webs 2
   Not forming prominent nests or webs 3
2. Nests in crotches of apple and wild cherry in May, Eastern Tent Caterpillar, p. 125
   Nests terminal, July to September........Fall Webworm, p. 120
3. Caterpillars feeding in clusters on apple 4
   Caterpillars feeding singly on apple 5
4. Striped lengthwise with brown and yellow; with dorsal spines and prominent red hump on fourth segment, Red-humped Caterpillar, p. 126
   Striped lengthwise with brown and yellow; with slender hairs and with yellow cervical shield, Yellow-necked Caterpillar, p. 127
5. Caterpillars conspicuously hairy 6
   Caterpillars without prominent hairs 7
6. Gray or brown caterpillars, with hairs not arranged in tufts; five pairs of blue spots, six pairs of red spots, Gipsy Moth, p. 122
   Caterpillars with black, white or buff hairs arranged in distinct tufts and pencils......................Tussock Moths, p. 121
7. Covered by a thin web on surface of leaf, often curling it, Apple and Thorn Skeletonizer, p. 126
   Not covered by web; green or gray, smooth larvae which loop in crawling ....Cankerworms, p. 120
8. Bright green beetles with coppery wing-covers, Japanese Beetle, p. 127
   Smaller tan-colored beetles with long sprawling legs, Rose Chafer, p. 128
9. Brownish, slimy slugs feeding on upper surface of pear and cherry leaves ....Pear Slug, p. 129
   Grayish larvae on currant and gooseberry, Imported Currant Worm, p. 129

10. Caterpillars injuring buds in spring, devouring apple buds set the preceding summer.............Climbing Cutworms, p. 130
Gray snout beetle in May devouring buds of the new growth of pear ....New York Weevil, p. 131

B. Borers in Trunk or Branches:
11. Large larva, white with black spots, tunneling in trunk or larger branches ....Leopard Moth, p. 120
Larva white, without black spots, tunneling in apple trees at base of trunk 12
12. With broad head, making gallery under the bark, Flat-headed Apple Borer, p. 131
With cylindrical head, making gallery in the wood, Round-headed Apple Borer, p. 131
13. Burrowing in tender terminal twigs of peach, Oriental Peach Moth, p. 132
Burrowing at base of trunk of peach........Peach Borer, p. 132
14. Tunneling at base of twigs; brood chambers under the bark; small round emergence holes in bark...Shot-hole Borer, p. 133
Tunnels in pith of currant stems, Imported Currant Borer, p. 134

C. Sucking Insects on Leaves, Shoots, or Bark:
15. Greenish aphids on apple leaves and new shoots, Green Apple Aphid, p. 134
Aphids with white wax secretion on apple leaves or bark, Woolly Apple Aphid, p. 135
16. Dark brown aphid on cherry, curling the leaves, Black Cherry Aphid, p. 136
Green aphid on currant, blistering the leaves, Currant Aphids, p. 136
17. Small, circular, dark gray scale insects on bark, raised nipple in center ....San José Scale, p. 137
Elongated, curved scales, same color as bark, Oyster-shell Scale, p. 123
Pear-shaped, light gray scales on apple, pear, hawthorn, and mountain ash ....Scurfy Scale, p. 137
18. Active, greenish-white insects on under side of leaves, causing white peppered appearance on upper surface of apple, Leaf Hoppers, p. 138
Grayish bug puncturing tips of new shoots, dwarfing and distorting growth ....Tarnished Plant Bug, p. 139
19. Mites causing blisters on new leaves of apple and pear, Pear Leaf Blister Mite, p. 140
Red mites causing apple leaves to turn brown in midsummer; winters as red eggs on bark........European Red Mite, p. 140

EASTERN TENT CATERPILLAR (*Malacosoma americana* Fabr.)

Makes nests or tents in the crotches of apple and wild cherry trees in early spring, and is often found on pear, peach, and plum. This is a one-generation insect. Caterpillars reach a length of about two inches and are brown, with a white line along the back, more or less blue along the sides and sparsely covered with light brown hairs. They feed outside the nest and leave a strand of

silk wherever they travel along a twig or branch. They reach full size in early June, crawl about for a few days, then under rubbish or in protected places spin white, oval cocoons about an inch long. Two weeks later, emerge the fawn-colored moths which fly at night, mate, and the females during July lay on the twigs clusters of eggs which hatch the following April. These clusters are in the form of cylinders partially or entirely encircling the twigs, and covered with a tough, glue-like substance to protect the eggs. Egg-mass, caterpillars, and nest are shown on Plate III, c, d, and e.

The remedies are: Clip off and burn the egg clusters during the winter; rub off the nests when first formed, and crush the young caterpillars; spray the foliage with lead arsenate.

(Bulletin 177).

FALL WEBWORM. See page 120

APPLE AND THORN SKELETONIZER (*Hemerophila pariana* Clerck)

For the past few years, small, slender caterpillars feeding under webs on the upper surface of apple leaves have been rather common. It is a European pest first appearing in this country in Westchester County, New York, whence it has spread over the New England States, eastern New York and portions of New Jersey and Pennsylvania. There are three generations each year, with a partial fourth in certain seasons. In 1923, nearly all unsprayed apple trees in central Connecticut were skeletonized and brown in July. Since then it has subsided, and though careful search shows it to be present in nearly every orchard, it has done little harm and most of the caterpillars apparently have been either parasitized or eaten by birds, and have not developed to the adult stage. Eggs are laid singly on the under side of leaves. The caterpillars feed at first on the lower surface, but when about one-third grown they move to the upper side and spin a light web across the leaf, often curling it, and feed beneath the web. White cocoons are often made on the leaves. Injured leaf and cocoon are shown on Plate IV, a. Apparently the insect hibernates in the adult form, which is a small brownish or grayish moth, often with purplish tinge. It rests on window-screens with folded wings, forming a triangle, each side of which is about one-fourth of an inch.

This insect is easily controlled by a spray of lead arsenate.

(Bulletin 246).

CANKERWORMS. See page 120

RED-HUMPED CATERPILLAR (*Schizura concinna* S. & A.)

In late summer, curious caterpillars are often found feeding in clusters on young apple trees, sometimes defoliating them. These

caterpillars reach a length of one and one-half inches and are striped lengthwise with fine lines of yellow, black and white. Spines are borne on the back, but these are longest on the fourth segment, which is dorsally enlarged and a bright coral red, giving the caterpillar its common name. Instead of resting on leaf or stem in the usual position of most caterpillars, the tail end of the body is elevated, as shown on Plate VI, a. The adult is a light brown moth with a wing expanse of over an inch, and there is only one brood each year. The pupae live in the ground over winter.

The caterpillars may be gathered by hand and destroyed, or the foliage may be protected with a spray-coating of lead arsenate.

(Bulletin 203, and Report for 1917, page 329).

Yellow-Necked Caterpillar (*Datana ministra* Drury)

Another caterpillar which feeds in clusters on apple trees in nurseries and young orchards in late summer is the yellow-necked caterpillar. When fully grown it is nearly two inches long and is striped lengthwise with yellow and black along the back. Like other caterpillars of the genus *Datana*, when disturbed it elevates head and tail, as shown on Plate VI, b. Head and legs are black and shining, and an orange-yellow cross band next the head gives the insect its name. It is sparsely covered with rather short and weak light brown hairs. Only one generation occurs each year, the winter being passed by the pupae in the ground.

As these caterpillars feed mostly on young trees and in clusters, it is easy to remove and destroy them, or the foliage may be protected by spraying with lead arsenate.

(Bulletin 203, and Report for 1917, page 328).

Gipsy Moth. See page 122

Tussock Moths. See page 121

Japanese Beetle (*Popillia japonica* Newman)

This insect from the Orient was first discovered in this country at Riverton, New Jersey, in 1916. Since then it has spread over most of New Jersey, eastern Pennsylvania, western Long Island and Westchester County, New York, into Connecticut as far as Bridgeport, and in 1927 it was found in Washington, D. C., and at several points in Maryland.

There is only one generation each season, and the insect passes the winter as a grub or larva in the soil. The beetles emerge from June 15 to August 15, most of them coming out in July. The grubs feed upon grass roots, and the beetles devour the foliage and fruit of most kinds of fruit trees, the foliage of many shade

trees and ornamental shrubs, as well as the flowers and leaves of many annual and perennial plants. Nursery plants with soil on the roots are liable to contain larvae, and if not treated, they may be transported in this manner. The beetle, egg and grub are shown in Fig. 15, and beetles and rose leaves injured by them are shown on Plate IV, b. and c.

The remedies are: treating the soil with carbon disulphide emulsion; spraying the foliage with coated lead arsenate; spraying the beetles with oleoresinate of pyrethrum. It is a difficult pest to control.

(Report for 1926, page 244).

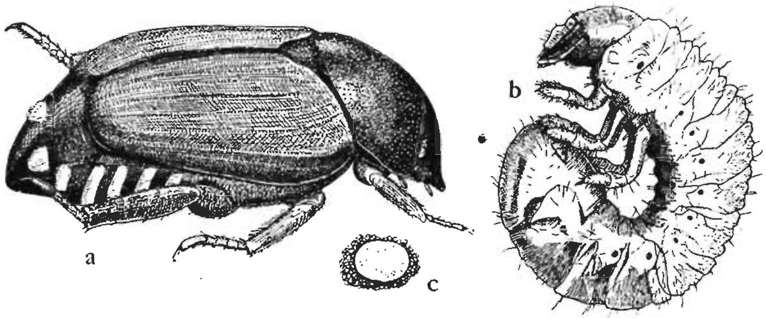


FIG. 15. The Japanese beetle. a. adult beetle; b, grub or larva; c, egg. All enlarged about five times.

THE ROSE CHAFER (*Macrodactylus subspinosus* Fabr.)

The rose chafer occurs from Canada south to Virginia and Tennessee and west to Colorado and Oklahoma. The region of its greatest abundance, and therefore of its greatest destructiveness, is in southern New England and the Middle Atlantic States.

The injury to the foliage and fruit is done by the adult beetle. The rose chafer is a yellowish-brown beetle about one-third of an inch long and with long sprawling legs. The larva or grub is yellowish-white with pale brown head; it lives in the ground and is rarely seen. The adult beetles feed upon the leaves of a number of plants, as well as flowers and fruit. They are very fond of grape blossoms and newly set fruit, often destroying the entire crop. Roses and peonies, especially the light-colored varieties, are often ruined by this insect. In nurseries grape leaves are sometimes partly eaten. Hydrangeas were injured quite severely in 1927. The work of this insect is shown in Fig. 16, and on Plate V, a.

The beetles emerge from the ground and attack the plants usually about the second week in June in Connecticut. Soon after emerging, the beetles mate, and the female lays her eggs singly in

the ground, usually depositing from 24 to 36 eggs. These eggs soon hatch, and the young larvae feed on the roots of grass and other plants until fall, when they descend deeper into the soil below the frost line. In the spring the grubs ascend, transform to pupae in earthen cells, and the beetles emerge two to four weeks later.

The rose chafer is an exceedingly difficult insect to control by ordinary measures. The best remedy known is to cover the foliage with a heavy application of arsenate of lead. In vineyards, hand picking is sometimes recommended to protect the blossoms

FIG. 16. Rose chafer.

and newly set fruit from being eaten by this insect. In New Jersey, self-boiled lime-sulphur is an effective repellent on fruit trees.

(Report for 1916, page 111).

THE PEAR SLUG (*Eriocampoides limacina* Ratz.; *Caliroa cerasi* Linn.)

In late summer the leaves of pear stock are often eaten by soft, slimy, brown, slug-like worms which feed upon the upper surface. Cherry leaves are likewise injured. This has been called the cherry and pear slug, and several scientific names have also been applied to it. It is the larva of a sawfly, and there are two generations each season. This insect is shown in Fig. 17.

The pest is easily controlled by spraying or dusting with lead arsenate or fresh hellebore.

(Report for 1920, page 199).

IMPORTED CURRANT WORM (*Pteronidea ribesi* Scop.)

This insect often defoliates currant and gooseberry bushes in nurseries. The adults of the currant worm spend the winter months in the ground and emerge during the latter part of April or early May. They lay their eggs on the under side of the leaves. In about a week or ten days the eggs hatch, and the young larvae

begin to feed on the tender leaves. After they are full grown, they enter the ground and spin small brown cocoons, from which the adults for the second brood emerge. Shown in Fig. 18.

The control measures for this insect are very simple. Usually one application of arsenate of lead, either in the form of dust or spray, will hold it in check. If the fruit is to be picked and sold, it is better to dust the plants with hellebore, as this soon washes off and is not so poisonous to man as arsenate of lead.

(Report for 1902, page 170).

Climbing Cutworms

Apple trees in nursery rows and in newly set orchards have been injured in Connecticut by climbing cutworms. In May, 1925, on apple stock in Durham, the buds which had been set the preced-

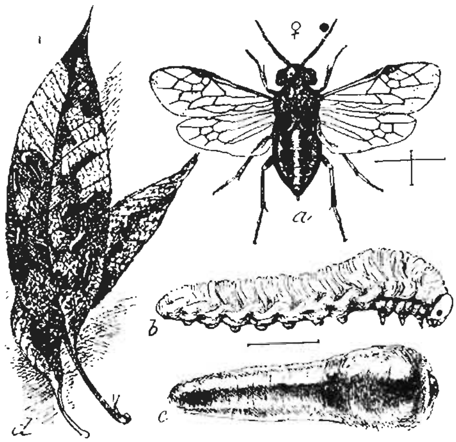


Fig. 17. Pear slug. a, adult sawfly, female; b, larva with slime removed; c, larva in normal state; d, leaves and larvae, natural size; a, b, c, much enlarged. (After Marlatt, Circular 26, Division of Entomology, U. S. Department of Agriculture).

ing summer were eaten off (see Plate VI, c), and raspberry plants near by had also been stripped. Two species of cutworms were responsible, and when reared, the adults proved to be *Agrotis unicolor* Walker (formerly *Noctua clandestina* Harris) and *Noctua fennica* Tausch. In May, 1926, similar injury occurred on grafts set in young orchard trees in Wallingford, and was caused by the dingy cutworm, *Feltia subgothica* Haworth. In May, 1922, raspberries in East Haven were injured by cutworms, and from the material two moths were reared, *Paragrotis messoria* Harris and *P. tessellatus* Harris. The same season larvae of *Noctua c-nigrum*

Linn. injured strawberry plants in a field near New Haven. As the injury is seldom noticed until too late, treatment is ineffective. In certain cases a liberal application of lead arsenate may protect the plants.

(Bulletin 247, and Report for 1922, pages 373, 375; Bulletin 275 and Report for 1925, page 324; Bulletin 285, and Report for 1926, page 276).

New York Weevil (*Ithycerus noveboracensis* Först.)

Though the injury is not common, occasionally young pear and plum trees are injured by this weevil, which eats into the bases of new shoots, sometimes nearly severing them. In a young orchard in Wallingford in 1908, injury by this weevil was quite prominent

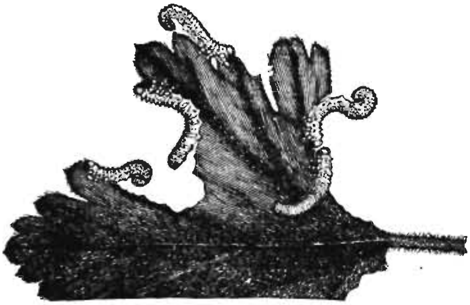


Fig. 18. Imported currant worm.

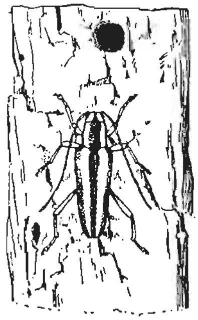


Fig. 19. Round-headed borer.

the last week in May. The insect is a snout beetle about half an inch in length, gray or slightly reddish, marked with quadrate black spots.

Spraying with lead arsenate proved an effective remedy.

(Report for 1908, page 845).

Leopard Moth. See page 120

Apple Tree Borers

There are two common species of borers which attack apple trees in Connecticut. They are known as the flat- and round-headed borers.

The round-headed borer, *Saperda candida* Fabr., usually attacks the main trunk of the trees near the base. The adult is one of the long-horned beetles and may be easily recognized by two straight white lines running lengthwise on its back (see Fig. 19). The eggs are laid during the summer, and the young borers tunnel just

under the bark until winter. The following year they tunnel into the sapwood and the third year feed directly in the solid wood. By this time the borers are quite large and do much damage to young trees, often killing them. The best remedy is to cut them out with a knife. Often a wire with a barb near the end is very useful to push into the tunnels and draw out the borers. The insect sometimes attacks other trees beside apple, quince being a favorite host, as well as *Crataegus* and mountain ash. The presence of borers may be noted by sawdust on the ground at the base of trees, which the borers have pushed from their burrows.

(Report for 1907, page 333).

The flat-headed apple tree borer is the larva of a Buprestid beetle, *Chrysobothris femorata* Fabr. As a rule, this insect attacks only trees that have been weakened by some other cause. It attacks a large variety of trees and has often been found in dry cordwood.

The borer seldom produces any visible castings, but its presence may be noted by a darkened and depressed area over the gallery. The larva when full grown is about an inch long and has a broad, flat head, from which it derives its name. It normally lives but one year in the tree, although under certain conditions it may live two years.

The remedy is to cut out borers when found and to keep trees in good condition by proper cultivation and fertilization.

(U. S. Farmers' Bulletin 1270, page 73).

Oriental Peach Moth (*Laspeyresia molesta* Busck)

This pest from the Orient is believed to have been brought into the United States on flowering cherries from Japan and has now spread throughout the Atlantic States as far north as Massachusetts and as far west as the Mississippi River. It has also been found in Ontario, Canada. There are three generations each season, and the larvae live through the winter in inconspicuous cases on the bark. The larvae tunnel in the twigs (see Plate V, b), causing the tips to die and the lateral buds to develop and form thick bushy tops. Though primarily an orchard pest, it often attacks nursery trees. No good remedies are known.

(Reports for 1925, page 280; 1926, page 234).

Peach Borer (*Synanthedon exitiosa* Say)

The adult of the peach borer is a wasplike moth. It lays its eggs in midsummer, and the borers hatching from them live in the trunks and often the larger roots until the following June or July, when they pupate in their burrows. The adults emerge to lay eggs for the next generation. This borer is shown on Plate VI, d.

The only satisfactory remedy on nursery trees is to cut open the burrows and kill the borers. A small piece of wire is very useful to insert into the burrows to pull the borers out, saving considerable cutting of the trunk of the tree. The injury may easily be seen by masses of gum at the base of the tree. This gum is often full of small particles of wood which the borer pushes from the burrow. Older peach trees may be treated with paradichlorobenzene, but this treatment is not safe on nursery trees.

(Report for 1909, page 359).

Shot Hole Borer (*Scolytus rugulosus* Ratz.)

This insect attacks most of the fruit trees which are normally grown in Connecticut. The injury is caused by the larva of a small beetle which lays its eggs under the bark of weakened and sickly trees, rarely attacking vigorous, healthy trees. The eggs

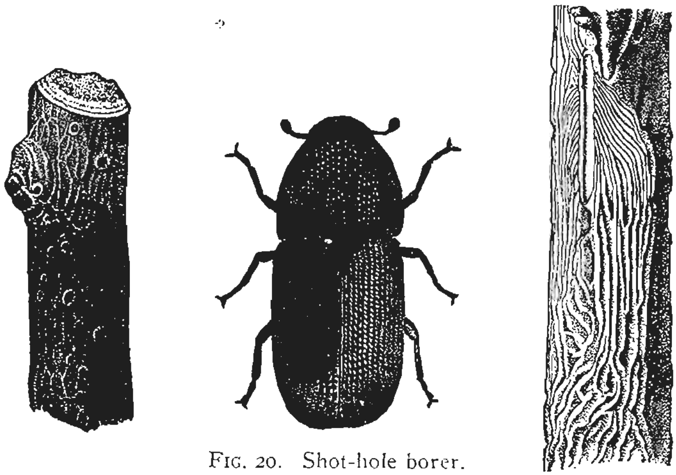


Fig. 20. Shot-hole borer.

hatch into small white grubs which bore just under the bark and slightly into the wood. The larvae live over the winter in these galleries and during the following summer transform to the adult stage and emerge from the trees, leaving small round holes in the bark. The bark of the infested trees looks as though it had been riddled by shot, and this fact gives the insect its common name. Occasionally the beetles tunnel at the base of small twigs, which may weaken the tree to such an extent that the grubs may live under the bark. This insect is shown in Fig. 20.

The only remedy is to cut out infested trees or branches and burn. Much can be done to prevent injury by removing sickly trees in or near the nursery and keeping all fruit stock in a vig-

orous growing condition by the application of nitrogenous fertilizer and by cultivation.

Imported Currant Borer (*Sesia tipuliformis* Clerck)

The adult is a clear-wing moth which appears in June, and the female lays eggs singly on the bark. The young larvae enter the stem and bore upward or downward in the pith, killing the stem. They are nearly full grown when winter approaches and hibernate in the burrows. The following May, each larva tunnels outward but leaves the burrow covered by a thin layer of bark. It then pupates in the burrow, and in June the moth emerges, leaving the pupa skin projecting from the cavity. There is only one brood each season. Infested canes appear sickly and should be cut off and burned before June 1 to kill the borers before the moths emerge.

(Fruit Insects, page 339).

Fig. 21. Green apple aphid. Eggs on twig; aphids on leaf.

Green Apple Aphid (*Aphis pomi* De G.)

This insect probably causes more injury to apple trees in the nursery than any other insect attacking apple trees in Connecticut. This was particularly true during the early summer of 1927, when these insects were very numerous and caused much injury by stopping growth and distorting young apple trees in Connecticut nurseries.

The insect passes the winter in eggs laid on twigs. The eggs are yellowish-green when laid, becoming glossy black. The young aphids hatch early in the spring, as soon as the buds begin to open, and start to feed on the young, unfolding leaves. No eggs are laid during the summer generations, the young aphids being born alive, and are ready to feed immediately. There are from 9 to 17 broods

produced during the season, following which the sexual individuals appear and deposit the overwintering eggs. This aphid is shown on Plate VII, b, and in Fig. 21.

Thorough spraying of the trees when the buds are opening in spring, using lime and sulphur at the rate of one part to nine parts of water, plus one pint of nicotine sulphate to every one hundred gallons of water, will be found of great value. Some of the miscible oils are also very good for this purpose, if the directions of the manufacturers are followed. Spraying at this time with either of these sprays will also help in the control of San José scale. During the summer, after the leaves have become curled, it is almost impossible to hit the aphids with any sprays. It is therefore necessary to dip the tips of the branches—where most of the aphids are found—in a pail of spray material consisting of one pint of nicotine sulphate to one hundred gallons water. It is very important that about four pounds of soap, previously dissolved in hot water, be added to the mixture. Other aphids may often be found on apple stock, but the above treatment is effective on all kinds of plant lice.

Woolly Apple Aphid (*Eriosoma lanigerum* Haus.)

This aphid differs from other aphids in the fact that it attacks its host plants both above and below the ground, and those that are above ground are covered by a white wax secretion resembling cotton (see Plate VII, c). These aphids often cluster in wounds, such as scars, cankers, and other injuries. The root form of this insect causes the roots to be deformed and covered with small galls.

The life history of this aphid is rather intricate but may be briefly outlined as follows: The eggs are laid in the crevices of the bark on elm trees in September and hatch in early spring. The aphids hatching from these eggs are wingless females and their young are also wingless, but the next brood produces winged adults which migrate to apple and sometimes to pear, quince, mountain ash and *Crataegus*. There are three summer broods, and in August winged females appear which migrate back to elm and lay winter eggs.

The aerial form may be controlled by spraying with kerosene emulsion or with nicotine sulphate and soap. The underground forms are harder to kill, as it is almost impossible to make spray permeate the ground sufficiently to kill the aphids. Carbon disulphide emulsion has been used with some success. One-half pound of carbon disulphide emulsion in four gallons of water poured into a shallow trench around the trees will kill the underground forms.

(Report for 1924, page 308).

Black Cherry Aphid (*Myzus cerasi* Fabr.)

The black cherry aphid is often very abundant on sweet cherry stock in nurseries. It is a black insect with a rounded abdomen, giving it a more or less globular appearance.

The eggs are laid upon cherry twigs in the fall and hatch early in the spring, often before the cherry buds open. They are able to withstand freezing, and as soon as warm weather comes and the buds open, they begin to feed and reproduce. This usually takes place in two or three weeks. Later broods become mature in less than a week. Some of the individuals of the later broods become winged and migrate to pepper grass, where they continue to reproduce until fall. They then migrate back to cherry and lay the overwintering eggs. Not all of the aphids migrate from cherry, and some can usually be found on it all summer, although during the latter part of the season they may not be very plentiful.

Control measures given for green apple aphids will be found useful for the cherry aphids. (See page 135).

(U. S. Farmers' Bulletin 1128, page 20).

Currant Aphids

There are several species of aphids causing injury to currant foliage. Their life histories are very similar and the same control measures would be equally effective on all species.

Perhaps the most common species in Connecticut is called the currant aphid, *Myzus ribis* Linn., which causes the terminal leaves to become much distorted, and little pits or pockets are formed on the under side of the leaves. The upper surface becomes more or less reddish in color, which is noticeable some distance away. When plants are heavily infested, these leaves fall, causing the plants to make a poorer growth.

The stem mothers hatch from eggs on currant twigs soon after the leaves develop in spring. Some of the young from the stem mothers develop wings and migrate to motherwort, hedge-nettle, and other related plants. The wingless forms remain on currants and continue reproduction. In each generation some winged individuals appear which migrate, but wingless forms are found on bushes until late summer. Early in October, migrants return and deposit the sexual females, which, when mature, mate with the winged males, and eggs are laid upon the twigs.

Spraying with nicotine sulphate and soap when the buds are opening will kill the stem mothers, or a later spray of the same material, directed upward to hit the aphids on the under side of the leaves, will hold the insects in check.

(U. S. Farmers' Bulletin 1128, page 28).

San José Scale (*Aspidiotus perniciosus* Comst.)

A number of years ago this insect was considered one of the most destructive scales infesting nursery stock. It is thought to have been introduced from China and was first found in this country in San José, California, about 1870. Since that time it has been spread through the principal fruit and nursery districts of the United States.

The general use of dormant and summer sprays, together with its natural enemies, has so reduced its numbers that it is not considered so serious a menace as formerly. Occasionally, however, nursery trees are nearly killed by this insect. This is particularly true of fruit stock which has been heeled in for a few years; it invariably becomes infested with scale and must be destroyed. Apple, pear, and peach trees are its favorite food plants, but other fruit trees, as well as shrubs and shade trees, are often attacked.

The scale or covering beneath which the insect lives is circular, about the size of a pin-head, grayish in color, with the central portion raised, and is shown in Fig. 22, and on Plate VII, a.

The best method of control is to spray the trees while dormant with a lime-sulphur solution, using one part to nine parts of water, or with one of the many miscible oils now on the market, following the manufacturer's directions.

(U. S. Farmers' Bulletin 1270, page 62).

Oyster-Shell Scale. See page 123

Scurfy Scale (*Chionaspis furfura* Fitch)

Apple and pear trees, as well as other common deciduous trees and bush fruits, are often attacked by the scurfy scale, which retards the growth and sometimes causes the death of the trees if the infestation is severe. This insect is a native of the United States, but is most common in the New England and Middle Atlantic States. It is easily recognized by its dirty-white color and pear-shaped scale in the female. and the white elongated scale of the male, as shown on Plate VII, f.

The insect winters in the egg stage, the eggs being found under the female scales. The eggs and the young scales are purplish, tinted with red, and hatch the last week of May. In the North there is but one brood each season, but farther south there may be two or three broods.

A dormant spray of lime and sulphur, or a miscible oil, applied as for San José scale, will usually control the scurfy scale.

(U. S. Farmers' Bulletin 1270, page 65).

Leaf Hoppers on Apple

There are two species of leaf hoppers commonly found on apple stock in Connecticut nurseries. They are quite similar in appearance but their life histories, as well as the injury they cause to growing apple trees, are quite different.

The leaf hopper causing the most injury to young apple trees is known as the apple leaf hopper, *Empoasca mali* LeBaron, shown in Fig. 23. The other is commonly known as the rose leaf hopper, *Empoa rosae* Linn. The injury caused by the former is very noticeable on young trees, where it attacks the tender terminal leaves, causing them to become reduced in size, curled, and misshapen. The effect of feeding by the insects is to make the tips and edges of the leaves brown and dry.

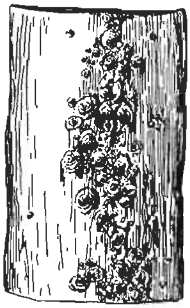


Fig. 22. San José scale.

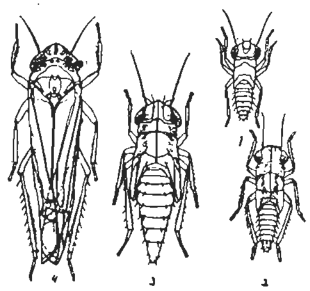


Fig. 23. The apple leaf hopper, in its different stages. (After Washburn, 9th Report State Entomologist of Minnesota).

The life history of the apple leaf hopper is as follows: The adults pass the winter under fallen leaves or any other convenient shelter. When the weather becomes warm in the spring, they leave their hibernating quarters and go to the young apple leaves to feed. Later the eggs are laid under the lower epidermis of the leaves and hatch in a short time. Three generations are produced each year, the last one hibernating.

The so-called rose leaf hopper makes the apple leaves appear more or less stippled or mottled. Leaves seriously infested by this insect are unable to function properly, and in extreme cases fall to the ground, interfering with the proper growth of the trees.

This insect is believed to have been introduced from Europe, perhaps on nursery stock, and is now widely distributed throughout the United States. Among its food plants, besides apple, are grape, raspberry, currant, gooseberry, blackberry, elm, oak, and others, though rosaceous plants are preferred.

The leaf hopper passes the winter in the egg stage. The eggs are deposited beneath the bark of apple and rose, producing tiny, raised, blister-like spots. They hatch in early spring, and the young are mature early in summer. The eggs for the second brood are deposited in the veins of the leaves. There are two broods each season.

Control measures are the same for both species: A spray of one pint of nicotine sulphate in a hundred gallons of water in which four pounds of soap have been dissolved will be found very effective if applied when the first generation is still young. The spray must strike the underside of the leaves where the young leafhoppers feed.

(U. S. Farmers' Bulletin 1128, page 26).

TARNISHED PLANT BUG (*Lygus pratensis* Linn.)

This insect injures peach stock by puncturing the tip of the tender new shoots, sucking out the juices, and probably injecting

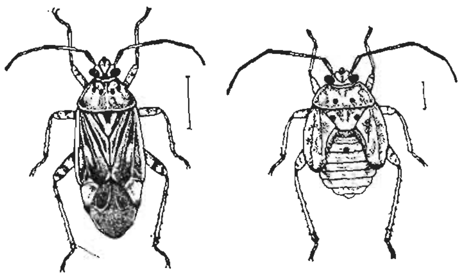


FIG. 24. Tarnished plant bug: adult at left: last stage of nymph at right. Enlarged about four times. (After Chittenden, Bulletin 43, Bureau of Entomology, U. S. Department of Agriculture).

some poisonous substance into the tissues, which soon die. This injury is called "stop-back" or "bush-head." Pear and apple trees, and many flowering plants are also injured by the tarnished plant bug. The female lays eggs in the tender shoots or in the petioles or veins of the leaves. The young bugs are yellowish-green and pass through five stages before the mature winged form appears. Both nymph and adult are shown in Fig. 24. There are probably several generations each year, and all stages may be found from May until November.

All weeds and rubbish around the field should be destroyed by burning or plowing. Spraying heavily with nicotine solution and soap will probably kill the nymphs.

(Missouri Bulletin 170, page 17).

PEAR LEAF BLISTER MITE (*Eriophyes pyri* Pag.)

The pear blister mite attacks the foliage of apple and pear but rarely causes any serious injury to apple foliage. On pear it is often a serious pest, causing a slowing up of tree growth, making undersized pear stock. It produces on the foliage small reddish or greenish galls or blisters which, after a time, turn brown, spotting the leaves with dead areas, as shown on Plate VII, e. When the galls are abundant, the tissues become dead, and the injured leaves have a brownish, shriveled appearance and often drop.

This mite is of European origin, but is now widely distributed wherever pears are grown.

The winter is passed in the adult stage under the bud scales. The adults are very small, elongate, whitish insects. In spring when the leaves are unfolding, the mites enter the leaves through the lower epidermis, and their activities soon produce their characteristic galls, in which they live and multiply. After reaching maturity, the mites desert the old galls, make new ones, and produce a new generation. The process continues until cold weather, when the adults migrate to the bud scales for the winter.

Spraying while the trees are dormant with lime-sulphur solution as for San José scale will hold this mite in check. Summer sprays are of doubtful value, the mites being inside the leaves and protected from the action of the sprays.

(Report for 1910, page 700).

EUROPEAN RED MITE (*Paratetranychus pilosus* Can. & Fanz.)

The work of the European red mite was first noticed on orchard trees in Connecticut in 1920. Since then it has caused considerable injury to orchard trees throughout the State.

The presence of mites on the foliage is usually indicated by the leaves turning brown, if the infestation is severe. A light infestation gives the foliage a sickly color and interferes with the proper functioning of the leaves.

The mite has been found on apple, cherry, plum, peach, pear, rose, and elm, although most of the real injury in Connecticut has been noticed on apple.

The eggs of the European red mite may be found on the branches and twigs of infested trees during the late fall and winter, as are shown on Plate VII, d. They are reddish in color and .15 mm. in diameter. When plentiful, they give the twigs the appearance of being covered with brick dust. The eggs hatch during the latter part of April or early in May, and the young mites make their way to the young leaves, where they begin to feed. They reach maturity in about three weeks and begin to lay eggs for the next brood. There are several broods in a season.

The best-known remedy is to spray in early spring, just before the eggs hatch, with one of the miscible oils. Lime-sulphur may be used, but is not as effective as an oil spray. Care must be taken to spray thoroughly, hitting all the eggs. If many of the eggs are missed in spraying, they will hatch and breed fast enough, under favorable conditions, to give rise to a serious infestation later in the summer. If mites become plentiful during the summer, a spraying of linseed oil emulsion will be effective, using one gallon of linseed oil and one and one-quarter pounds of soap to one hundred gallons of water.

(Bulletin 252).

INSECTS INJURING DECIDUOUS SHADE AND FOREST TREES

Key

A. Feeding upon the leaves:

1. Mining in leaves of larch..............Larch Case Bearer, p. 142
   Mining in leaves of locust.............Locust Leaf Miner, p. 143
   Making blotch mines in birch leaves,
   Imported Birch Leaf Miner, p. 143
2. Skeletonizing the leaves 3
   Devouring the leaves, except the larger veins 5
3. On poplar and willow 4
   On birch ....Birch Skeletonizer, p. 144
   On elm ....Elm Leaf Beetle, p. 144
4. Small, dark blue or green beetles; mostly bright green, 2-4 mm. long ....Willow Flea Beetle, p. 145
   Mostly dull blue, 4-5 mm. long,
   Imported Willow Leaf Beetle, p. 145
   Larger beetles, 7-10 mm. long, light brown, marked with black longitudinal lines, on poplar....Cottonwood Leaf Beetle, p. 145
   Marked in the form of irregular black dots,
   Spotted Willow Leaf Bettle. p. 145
5. Forming webs or nests 6
   Not forming webs or nests 7
6. Large loose webs on ends of branches in late summer,
   Fall Webworm, p. 120
   Small close webs on twigs of poplar....Poplar Tent Maker, p. 146
7. Feeding upon broad-leaved deciduous trees 8
   Devouring leaves of larch...................Larch Sawfly, p. 146
8. Larger, hairy caterpillars, non-loopers 9
   Smaller, smooth caterpillars which loop in crawling,
   Cankerworms, p. 120
9. Conspicuously marked with black, white, or yellow tufts of hairs,
   Tussock Moths, p. 121
   Caterpillars gray or brown, with two rows of dorsal tubercles; first five pairs blue, remaining six pairs red..Gipsy Moth. p. 122

B. Tunneling in the Wood:

10. Larvae white, without legs 11
    Larvae white with dark brown spots, with legs,
    Leopard Moth, p. 120
11. Round-headed larvae 12
    Flat-headed larvae in white birch......Bronze Birch Borer, p. 147
12. Tunneling in base of linden..................Linden Borer, p. 148
    Tunneling anywhere in trunk of black locust, Locust Borer, p. 148
    Tunneling in trunk and branches of poplar and willow,
    Poplar and Willow Borer, p. 149

C. Sucking Insects:

13. Green or white, woolly plant lice, visible on leaves 14
    Small red objects, hardly visible on leaves............Mites, p. 150
14. Green plant lice on leaves...................Green Aphids, p. 150
    White woolly plant lice on beech leaves,
    Beech Woolly Aphid, p. 151
15. Scale insects fixed on bark 16
    Large brown plant lice on bark of twigs ....Willow Aphids, p. 151
16. Hemispherical or globular, brownish or greenish scale insects on twigs 17
    Pear-shaped, white, gray or brownish scales 21
17. Scales hemispherical 18
    Scales globular, on oak ....Oak Gall Scale, p. 151
18. Scales brown, without white wax secretion 19
    Scales brown, with conspicuous secretion of white wax 20
    Scales greenish-yellow, in pits on the bark of English oak,
    Pit-making Oak Scale, p. 151
19. Scales large (6-8 mm.) on tulip tree......Tulip Tree Scale, p. 152
    Scales small (2-6 mm.), reddish-brown, on maple,
    Terrapin Scale, p. 152
    Larger than preceding, often clustered on many different kinds of trees and shrubs ....European Fruit Lecanium, p. 123
20. Chocolate brown with white wax fringe in crevices of bark on elm ....European Elm Scale, p. 153
    Medium brown on twigs of maple; white ovisac develops and becomes very prominent under posterior portion of body,
    Cottony Maple Scale, p. 153
21. Gray or dirty white on elm twigs........Elm Scurfy Scale, p. 154
    Gray or brownish, often same color as bark, on a great variety of trees and shrubs....................Oyster-shell Scale, p. 123

Larch Case Bearer (*Coleophora laricella* Hubn.)

The young larvae of the larch case bearer tunnel out the outer half of each needle, and when it is completely hollowed out, cut it off at the base of the excavated portion and use the latter as a case, living in it and carrying it about while feeding. They spend the winter in these cases, fastening them to the twigs by silken threads. When warm weather comes in the spring, the larvae dislodge their cases and migrate to the leaves, upon which they feed. They also cut off other needles to enlarge their cases and continue to do this until May, when they pupate within the cases. The adults

emerge the latter part of May and lay their eggs upon the leaves during the early part of June. The adult is a small moth with a wing expanse of about 9 mm. It is silvery grayish-brown in color with narrow front and rear wings having a long fringe.

There is no practical method of controlling this insect in forests or large plantations, but on shade or ornamental trees spraying is effective. If the trees are sprayed with lime-sulphur at the rate of one part to seven parts of water before the new leaves start in the spring, many larvae will be killed in their hibernating quarters. Spraying with arsenate of lead seems to have no effect upon this insect.

(Report for 1923, page 288).

Locust Leaf Miner (*Chalepus dorsalis* Thunb.)

The adult of this insect is a beetle about one-fourth of an inch in length, with head, legs, and an area along the middle of the wing-covers, black; the thorax and remaining portion of the wing-covers are orange-red.

The eggs are laid on the under sides of the leaves in May, and the larvae are miners within the leaves, and pupate there. The beetles emerge from the mines in July and fly about, soon laying eggs for the second brood, which reaches maturity in the fall. The beetles hibernate under the dead bark of trees, cracks and crevices, and under rubbish. Though the black locust is the preferred food plant and is therefore the most severely injured, this insect also attacks dogwood, elm, oak, beech, cherry, and several other species of trees.

Locust trees may be protected from this insect by spraying with lead arsenate to which a little molasses has been added.

(Ohio Bulletin 332, page 231).

Imported Birch Leaf Miner (*Fenusa pumila* Klug)

The adult of this insect is a small black sawfly which has somehow been introduced from Europe. First noticed in Connecticut in 1923, the adults were reared and identified in 1924, and the insect has now spread throughout New England and eastern New York. There are apparently three generations each year, the winter being passed as pupae in the ground. The larvae make blotch mines on the tender or terminal leaves, as are shown on Plate VIII, a, especially on sprouts or low trees of the gray birch, the paper birch, and the European white birch. Several larvae in a leaf unite in mining the entire leaf. No remedy is known.

(Report for 1924, page 340).

BIRCH SKELETONIZER (*Bucculatrix canadensisella* Chambers)

This is a native American insect of periodical abundance, and there is an annual generation which hibernates in ribbed cocoons on old leaves on the ground. The adult moths emerge and lay eggs in June and July. The eggs hatch in 15 days, and the young larvae for the first three instars (on the average, about four weeks) mine in the leaves. They then emerge and feed upon the under side of the leaves, skeletonizing them. They molt in white, circular or oval flattened cases on the leaves. The chief food plants are the gray, paper, yellow, and European white birches. The larvae and their work are shown on Plate VIII, b.

The remedy is to spray with lead arsenate.

(Bulletin 288).

ELM LEAF BEETLE (*Galerucella xanthomelaena* Schr.)

The work of the elm leaf beetle is found in the nurseries of the State nearly every year. Some seasons it is serious and must

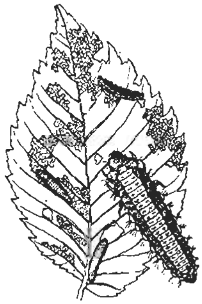


FIG. 25. Larvae and work of the elm leaf beetle.

interfere with the growth of the trees. It is another insect of European origin but has been in this country for nearly ninety years, and is distributed generally throughout the eastern United States. In the early nineties many fine old elms were destroyed by this beetle in southern New England.

The beetles live over the winter in houses, barns, church belfries and out-buildings. They leave their winter quarters in early spring, mate, and, as soon as the leaves unfold, eat small round holes in them. In May or early June, the females lay small clusters of yellowish eggs on the under side of the leaves. Each female may lay five or six hundred eggs. In about a week the eggs hatch and the young larvae or grubs feed on the under side of the leaves, as shown in Fig. 25, and on Plate IX, b, become

full grown in about three weeks, and crawl down the trees to pupate on the ground. The pupa stage lasts about ten days. Then the adult beetles emerge and lay eggs for the second generation, which seldom does much damage in Connecticut, and go early into winter quarters.

There is no reason why this insect should be a serious pest in nurseries because it is easily killed by an application of arsenate of lead spray, using two pounds to fifty gallons of water. The best time to apply this is soon after the eggs have hatched, which is around the first of June.

(*Bulletin* 155).

Willow Flea Beetle (*Crepidodera helxines* Linn.)

This is a small, bright green or occasionally blue, metallic, jumping beetle, with rather prominent punctures on the wing-covers, and about one-tenth of an inch in length. It is often rather abundant on willows in nurseries, and the beetles eat many round holes in the leaves. It lives through the winter in the adult stage, but its life history is not well known. Spraying the foliage with lead arsenate is the remedy.

(Kentucky Bulletin 120, page 61).

Imported Willow Leaf Beetle (*Plagiodera versicolora* Laich.)

This insect has recently become established in the United States in the vicinity of New York City. It was first found in Connecticut at Greenwich in 1921. At that time the beetles and larvae were quite numerous and were defoliating willows. Since then the insect has spread over the State and can be found in nearly all nurseries where willows are grown. The beetles appear late in April or early May and feed for some time; then deposit eggs. The beetles are moderately stout, about one-eighth of an inch long, and of a dark, metallic-blue color. When the eggs hatch, the young, bluish-black grubs feed on the under side of the leaves, often skeletonizing them. This insect and its work is shown on Plate IX, c.

Spraying with lead arsenate is effective.

(Report for *1921*, page *195*).

Cottonwood Leaf Beetle (*Lina scripta* Fabr.), Spotted Willow Leaf Beetle (*Lina lapponica* Linn.)

These insects are well-known pests of poplars and willows. In Connecticut most of the injury is done to Lombardy and Carolina poplars. Both species of beetles cause injury, but *Lina scripta* is the more common in this State.

The life history, habits, and the control measures are about the same for both species, so they may be treated together in this paper.

The beetles appear early in the spring when leaf growth starts, and begin to feed on the foliage. In a short time oviposition takes place, and the reddish-yellow eggs are laid in clusters on the under side of the leaves. From these hatch small black grubs which skeletonize the under surface of the leaves. As they grow larger they eat out ragged holes in the leaves and often leave only the midribs. When full grown they pupate on the leaves and soon the adults emerge. There are three broods in a season.

Spraying with arsenate of lead, using three pounds to a hundred gallons of water, will control this pest. An effort should be made to spray the under side of the leaves, as the young grubs feed only on the lower surface until they are about half grown. The smooth surface of the poplar and willow leaves causes the spray to roll off or collect in drops, but this may be overcome by adding a spreader like calcium caseinate, mixing one pound with a hundred gallons of the spray mixture.

(Ohio Bulletin 332, pages 259, 261).

Fall Webworm. See page 120

Poplar Tent-Maker (*Melalopha inclusa* Hubn.)

The caterpillars feed gregariously upon the foliage of various kinds of poplars and willows and make small nests upon the twigs which resemble those of the brown-tail moth. Unlike them, however, the caterpillars do not remain in the webs through the winter.

There are probably two generations each year, as the moths are present in March, April, and May, and again in July and August. The full-grown caterpillar is about an inch and a half long, dark brown, with narrow yellow stripes extending lengthwise. The head and legs are black, the under surface of the body honey-yellow. The fourth and eleventh segments each bear a closely set pair of high, pointed tubercles dark brown in color and somewhat hairy.

Spraying with lead arsenate is the remedy.

(Report for 1911, page 310).

Larch Sawfly (*Lygaeonematus erichsoni* Hart.)

The larch sawfly was first noticed in this country in Massachusetts in 1881. Since that time it has caused considerable injury to larch plantations. In Connecticut it has been reported from the

northern parts of the State where larch grows naturally. Both the adults and the larvae injure trees, the adults injuring the terminal twigs by inserting eggs, and the larvae eating the leaves. The adult female selects the young, green, terminal shoot in which to deposit eggs, causing it to die or severely injuring and distorting it. The eggs are laid in May and hatch in about ten days. The young larvae feed on the leaves and are full grown in three or four weeks. They then make cocoons under rubbish on the ground, where they spend the winter. The adults emerge the following spring. Larvae and cocoons are shown on Plate IX, a.

On small trees in nurseries, injury may be prevented by spraying with three pounds of arsenate of lead in fifty gallons of water. In woodlands the insect is hard to control because of the size of the trees and the difficulty in spraying. In Connecticut the best time to spray is early in June soon after the eggs have hatched.

(Report for 1915, page 125).

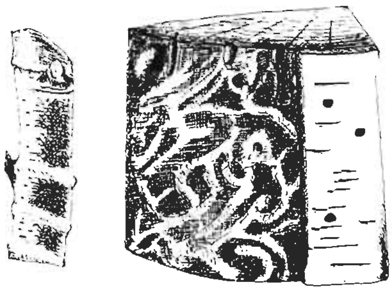


FIG. 26. Work of the bronze birch borer.

CANKERWORMS. See page 120

TUSSOCK MOTHS. See page 121

GIPSY MOTH. See page 122

LEOPARD MOTH. See page 120

BRONZE BIRCH BORER (*Agrilus anxius* Gory)

Many cut-leaf white birches in Connecticut have died during the past few years as a result of the attack of the bronze birch borer. The European white birch, *Betula alba,* is the species chiefly injured. Our native birches are seldom, though occasionally attacked by the insect.

Thinning of the foliage in the top of the tree is an indicati of the presence of the borer. Later, the top branches die, and tl following season the process continues until the tree is killed. careful examination shows ridges or swellings on the branches one half to one inch in diameter before anything is wrong with th foliage. Where the beetles have emerged there may be semi circular exit holes. Injured wood is shown in Fig. 26.

There is one annual generation each year. The larvae live through the winter in cells just under the bark and pupate early in May. The beetles emerge late in May or early in June and lay eggs in the crevices of the bark. The small larvae hatching from the eggs tunnel first near the bark and, as they grow larger, into the wood.

Infested trees should be cut and burned before June 1 to prevent the flight of the beetles from infested trees to healthy ones. As the adults feed to some extent upon the foliage, spraying with lead arsenate early in June is recommended.

(Report for 1922, page 359).

Linden Borer (*Saperda vestita* Say)

This insect often causes serious injury to young linden trees. In nurseries many have been injured at the base so that they break in wind-storms. See Plate X, b.

The adult beetle is black, covered by a dense olive pubescence, and usually has three black spots on each wing-cover, though these are sometimes absent. The beetles appear during the summer and after feeding on the green bark of growing shoots, leaf stems, and on the under side of leaves, they begin to lay their eggs. The females with their jaws make slight incisions in the bark where they lay their eggs. The grubs on hatching mine under the bark and into the wood. The injury takes place at or near the ground—never more than a foot from it—and sometimes in the larger roots.

The only remedy is to kill the borers. This may be done with a pointed knife or a wire. The borer may be extracted by means of a small wire with a barbed point like a harpoon.

(Report for 1915, page 186).

Locust Borer (*Cyllene robiniae* Forst.)

The adult is one of the long-horned beetles about three-fourths of an inch long, black in color, with bright yellow bands extending across the body. The insect is very destructive to our common locust, *Robinia pseudoacacia*, and also to the rose acacia, *Robinia hispida*. The beetles appear in September, when they may be found feeding on the blossoms of goldenrod. Eggs are

laid about that time in clusters or singly, on the roughened bark of trunks and branches. The young larvae hatching from them tunnel into the bark, where they spend the winter. In spring they resume feeding and go into the heart-wood. An enlargement forms at the entrance of the burrow, and in time the trunks of young trees become much deformed; on older trees the branches are injured.

Successful and practical measures for the control of this insect have never been found. If only a few trees are involved, the larvae may be dug from their burrows. Repellent washes applied to the trunks of trees during the egg-laying period have proven expensive and only moderately effective.

(Ohio Bulletin 332, page 316).

Poplar and Willow Borer (*Cryptorhynchus lapathi* Linn.)

This insect is one of the snout beetles or weevils and is about one-third of an inch long, dark gray in color, except the tips of the wing-covers, which are paler. (See Fig. 27). Injury is

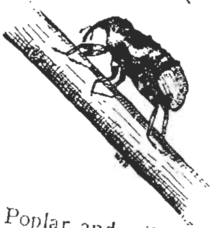


Fig. 27. Poplar and willow borer, twice enlarged.

ed by both adults and larvae. The adult punctures the bark ie trees and the grubs bore into the trunk and branches. The y, shown on Plate X, a, is greatest to nursery stock and newly ees; after the trees are older and well established, less in- occurs.

winter is passed in the larval stage within the host plant. dults appear late in July and are most abundant in August. g and egg-laying take place about ten days after emergence. station is indicated by dead patches of bark, dead or dying r limbs with irregular swellings or galls formed over tun-

remedy is to cut out and burn all infested wood before June, to prevent the grubs from reaching maturity. Prob- insect can be controlled by thoroughly coating the bark in h arsenate of lead. Painting the trunks of trees early with Carbolineum or some other repellent has also been nded.

Bulletin 332, page 319).

Sucking Insects

Mites

Though "mites" or "red spider" are not insects, there are several species which injure the leaves of trees, causing them to turn dull and brown the latter part of the season. Mites belong to the Order Acarina (Class Arachnida) and usually have four pairs of legs, thus differing from insects (Class Insecta) which usually have three pairs of legs in the adult stage.

In mite infestations pale, brownish spots are noticed on the leaves, which may later cover the entire foliage. When these spots are examined with a magnifying glass, tiny globular eggs, egg-shells, mites, and their cast skins may be seen.

One of the common mites in nurseries, especially on oak and maple, is *Paratetranychus bicolor* Banks. The European red mite, *Paratetranychus pilosus* C. & F. (See page 140), which is an important pest of fruit trees, also occurs on elm and probably on other kinds of shade trees. The common "red spider" of green-houses, *Tetranychus bimaculatus* Harvey (*telarius* Linn.) may injure the foliage of almost any tree species. With *T. bimaculatus*, evidently the adults hibernate, but with *P. bicolor* and *P. pilosus*, reddish or brownish eggs are laid in the fall on the bark of the trunk and branches. On hatching in spring, the young mites find their way to the leaves.

The remedies are: a dormant spray of a miscible oil (1 - 15) to kill the overwintering eggs; a summer spray of linseed oil emulsion to kill the mites. This emulsion may be made as follows:

1 gallon raw linseed oil
1.5 pounds soap flakes
1 gallon water

Dissolve the flakes in the water, stir in the linseed oil, and dilute to make 100 gallons.

(Bulletin 252).

Green Aphids

There are many species of green aphids attacking deciduous trees during the growing season. In fact, nearly every tree species has one or more species of aphids infesting its leaves. The aphids may occur in the winged or wingless forms. They suck the sap through their long pointed beaks and excrete a sticky substance called "honey dew," which drips upon the foliage, giving the leaves a varnished appearance. In the honey dew a black fungus or sooty mold grows, giving the leaves a blackened appearance. Ants feed upon the honey dew and are usually present on

aphid-infested trees, but the ants do no harm to the trees. The presence of aphids may be noticed also in some cases by the curled leaves or the abnormal dropping of the leaves.

Aphids may be killed by spraying with a contact spray like nicotine solution and soap, but they must be hit by it. As they are mostly on the under leaf surface, the spray should be directed there. Applications should also be made before the aphids are destructively abundant and before the leaves are curled or seriously injured.

Beech Woolly Aphid (*Phyllaphis fagi* Linn.)

Trees of the European beech, *Fagus sylvatica*, especially the purple-leaved form, are usually infested in Connecticut by a white woolly aphid which appears on the under side of the leaves in early summer. The woolly appearance is due to slender wax filaments secreted by the aphids.

They may be controlled like other aphids with a spray of nicotine solution and soap.

Willow Aphids

Large reddish brown aphids are often present in large numbers on the twigs of willows, where they lay eggs late in the season. These belong to the genus *Chaitophorus*, two species—*viminalis* Monell and *nigrae* Oest.—occurring in Connecticut. There is also an even larger species, *Longistigma caryae* Harris, which occurs on oak, hickory, maple, elm, poplar, linden, and sycamore. The remedy is that given above.

Oak Gall Scale (*Kermes* sps.)

Hard, globular scales occur on oak trees in nurseries and are usually gray or brown in color. There are several species, some smooth and shiny, some dull, and some pubescent. The partially grown females winter in the crevices of the bark, and some species in the spring go to the leaves. The young appear in July or August. The bodies of the females often remain on the twigs for nearly a year after they die. Shown on Plate XV, e.

Spraying the dormant trees in early spring with a miscible oil (1 - 15) is effective.

Pit-Making Oak Scale (*Asterolecanium variolosum* Ratz.)

This scale infests several species of oak but is most frequently encountered on English or golden oak, *Quercus robur*. It has a

smooth, glassy, convex shell about one-sixteenth of an inch in diameter and is of a beautiful greenish-golden color. A little pit is formed around each insect, from whence its common name arises. It is also called the golden oak scale. It is believed to be single-brooded, but this point has not been determined for Connecticut. The insect passes the winter in the egg-stage under the old shells, and the young appear in May and June. The insect is shown on Plate XI, c.

A dormant spray of a miscible oil (1 - 15) is probably the best means of control.

(Ohio Bulletin 332, page 306).

Tulip Tree Scale (*Toumeyella liriodendri* Gmel.)

This is our largest soft scale, the females being brown, hemispherical, and nearly one-third of an inch in diameter, shown in

Fig. 28. Tulip tree scale.

Fig. 28, and on Plate XI, d. The males are oval, gray, and flattened, and about an eighth of an inch in length. The scales usually occur on the lower branches of the tulip tree, and there is a single generation each year, the young appearing in September. The remedy is to spray as soon as the leaves fall, using a miscible oil or a nicotine solution.

(Report for 1921, page 176).

Terrapin Scale (*Lecanium nigrofasciatum* Pergande)

This is a small, oval, and very convex soft scale, reddish-brown in color, which infests the small twigs of maple trees (see Plate XI, b), especially the red and silver maples. On large trees it is more apt to be on the lower branches, and though not particularly a nursery pest, it is occasionally found on the nursery trees of larger size. The eggs are formed under the old shells in June and hatch late in June or early in July. Only the females live through

the winter, and they are in a partially grown state. The scales suck the sap from the twigs in fall and spring, becoming mature about June 1.

The remedies are contact insecticides, especially miscible oils (1 - 15), applied when the trees are dormant.

(Report for 1921, page 183).

EUROPEAN FRUIT LECANIUM. See page 123

EUROPEAN ELM SCALE (*Gossyparia spuria* Mod.)

This is a chocolate-brown scale, oval in shape, with a fringe of white wax around the margin, shown on Plate XI, a. It usually occurs in the crevices of the bark of trunk and larger branches. There is one generation each year, the insect hibernating on the bark in a partially grown state. The young appear in June. The standard contact sprays will kill this scale at almost any time of the year, though more thorough applications can be made when the trees are dormant.

(Report for 1905, page 235).

COTTONY MAPLE SCALE (*Pulvinaria vitis* Linn.)

This insect is perhaps the most conspicuous of all the scale insects on account of the abundant secretion of wax surrounding the eggs. During the winter it occurs on the bark and resembles any other large, brown, soft scale, but about the time the trees begin to grow, the posterior end of the insect becomes raised, and the egg-sac begins to protrude, as shown on Plate XI, e. When fully developed it is as long as the insect itself and resembles a tuft of cotton. Each female deposits about three thousand eggs, which hatch in late June or early July. The young at first go to the leaves and establish themselves mostly on the under side along the midrib and veins. Before the foliage drops, they return to the twigs and settle on the bark for the winter.

In Connecticut this insect has occurred abundantly only in the vicinity of Stamford and attacks silver and red maples, though all other kinds are also infested in some portions of the Middle West, where there are periodical outbreaks every eight or ten years. It occurs in Connecticut nurseries on a variety of trees, shrubs, and vines, but is seldom sufficiently abundant to cause injury. It is perhaps the most common on maple.

The remedy is to spray the dormant trees in early spring, using one of the miscible oils (1 - 15).

(Report for 1921, page 179).

Elm Scurfy Scale (*Chionaspis americana* Johnson)

This scale, which occurs on the twigs and branches of elm, is dirty-white or gray in color and somewhat resembles the oyster-shell scale. It passes the winter in the form of purplish eggs under the old shells, and there are two generations each season. Small branches are killed in severe infestations, and the general vitality of the tree is lowered.

Spraying the dormant trees with liquid lime-sulphur (1 - 8) or with one of the miscible oils (1 - 15) will control this insect.

(Ohio Bulletin 332, page 290).

Oyster-Shell Scale. See page 123

INSECTS INJURING SHRUBS AND VINES

Key

A. Feeding upon the leaves:

1. Conspicuous caterpillars, bearing horns or spines 2
   Conspicuous caterpillars, without distinct horns or spines...... 4
2. Caterpillars with horns or fleshy protuberances.............. 3
   Caterpillars 2-3 inches long, covered with branched stinging spines, pale green with reddish band along each side, Io Caterpillar, p. 155
   Caterpillars one inch long or less, each end with a pair of prominent tubercles bearing stinging spines; color brown with green saddle..........................Saddle-back Caterpillar, p. 155
3. Green caterpillars with single horn on tail, on grape or Virginia creeper.............Sphinx Caterpillars or Horn Worms, p. 156
   Brown caterpillars with fleshy protuberances on each side of thoracic segments, on Dutchman's pipe vine, Pipe-Vine Caterpillar, p. 156
4. Large fleshy caterpillars, 3-4 inches long, bluish-green, with prominent tubercles, usually feeding on rosaceous plants, Cecropia Caterpillar, p. 156
   Smaller (1-2 inches), finely cross-striped with black, white and orange, feeding upon Virginia creeper, Eight-spotted Forester, p. 157
5. Small, green, slug-like caterpillars on rose....Rose Sawflies, p. 157
   Larger, gray, slug-like caterpillars on *Lonicera*, Honeysuckle Sawflies, p. 158

B. Borers in stems:

6. White grub, about one inch long, tunneling in lilac or privet. Lilac Borer, p. 158
   Very small, flat-headed white grub, forming swellings on rose stems................................Rose Stem Girdler, p. 158

C. Forming galls on leaves:

7. Shiny, semi-transparent galls on leaves and tendrils of grape, Grape-vine Tomato Gall, p. 158
   Small pocket galls on leaves..............Eriophyid Mites, p. 159

D. Sucking sap from leaves or bark:

8. Scale insects protected by shells, mostly on bark.............. 9
Green plant lice on leaves..........................Aphids, p. 150

9. Female scale, circular or nearly so 10
Female scale, pear-shaped, dark gray, on Euonymus,
Euonymus Scale, p. 159

10. Female scales, 2-3 mm., snow-white, exuviae marginal, light yellow, eggs purple, on rose and blackberry......Rose Scale, p. 159
Same size, scale whitish but more or less covered with bark of host, exuviae marginal, orange-yellow; on cherry, privet, and *Catalpa bungei*.......................White Peach Scale, p. 159
Female scales less than 2 mm., dark gray, exuviae central, yellow,
San José Scale, p. 137

Io Caterpillar (*Automeris io* Fabr.)

This caterpillar is from two to three inches long when fully grown, pale green, with a reddish and white stripe along each side, each segment bearing a number of tubercles arranged crosswise in a row, as shown on Plate XII, c. Each tubercle has a number of spreading, stinging spines which cause an intense itching or rash on coming in contact with the human skin. Apparently there is only one generation each year, and the insect passes the winter in its cocoon among the leaves on the ground. The moths emerge in June and July. The female has a wing-spread of about three inches, and the male about two and one-half inches. The ground color is yellow with reddish markings, and in the female the entire fore wings are tawny. On each rear wing in both sexes there is a bluish eye spot margined with black, and with a white dash in the center; between the spot and the wing-margin are two concentric rings, one red and the other black.

The caterpillar feeds upon many kinds of shrubs and trees. Spraying with lead arsenate is the remedy.

(Ohio Bulletin 332, page 270).

Saddle-Back Caterpillar (*Sibine stimulea* S. & A.)

The caterpillars of this species are often gregarious and feed upon a large number of plants. They are nearly an inch long, without true legs, and are brown and green in color. Both ends of the body and the long tubercles are brown, but the middle of the body looks as though covered by a bright green blanket with an oval opening on the back, as shown on Plate XII, a. This gives it the common name "saddle-back." On the prominent brown tubercles, and laterally on the smaller green ones, there are branched, stinging spines which to the touch are quite painful for an hour or two. The reddish-brown moth has a wing-spread of about one and one-half inches. There is one generation annually.

Spraying with lead arsenate will prevent defoliation.

(Report for 1914, page 188).

Sphinx Caterpillars or Horn Worms

Grape vines, Virginia creeper, and Boston ivy are often eaten by caterpillars of this group. Most of them may be distinguished by the sharp horn on the back near the tail, as shown in Fig. 29, and several species belonging to different genera may be encountered. All belong to the family Sphingidae.

The abbot sphinx, *Sphecodina abbotti* Swains., has in place of the horn a shiny spot or tubercle. This caterpillar is brown, veined

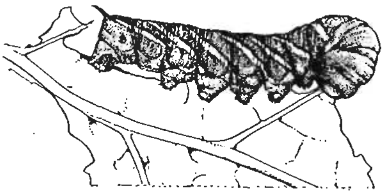


Fig. 29. A sphinx caterpillar or horn worm.

with a darker brown, but a form occurs having a large green patch on the dorsal portion of each segment.

All sphinx moths have large bodies and long narrow wings. They fly at dusk, poise with vibrating wings before deep-throated flowers, and for this reason are called "humming-bird moths."

Hand picking is the usual remedy, but if the caterpillars are injuriously abundant in nursery or vineyard, spraying with lead arsenate will prevent defoliation of the vines.

Pipe-Vine Caterpillar (*Papilio philenor* Linn.)

Wherever the Dutchman's pipe, *Aristolochia sipho,* is grown, the leaves may be eaten by the pipe-vine caterpillar. This caterpillar is velvety dark brown or black, marked with orange spots and bearing a number of long black and orange protuberances, and is shown with cocoon on Plate XII, d. When fully grown it is two inches or more in length. The adult is a swallow-tail butterfly having a wing-spread of 3-3.5 inches, velvety black with metallic bluish or greenish reflections. There are two generations each year.

Spraying the vines with lead arsenate is probably the best remedy.

(Holland's Butterfly Book, page 315).

Cecropia Caterpillar (*Samia cecropia* Linn.)

This is one of the largest caterpillars commonly found feeding upon nursery stock and is from 3-4 inches long when full grown

and about three-fourths of an inch thick. It has a peculiar bluish-green color with a cross row of tubercles on each segment; those on the second, third and fourth segments are red, the other dorsal ones yellow, with pale blue tubercles along the sides near the breathing pores. (Shown on Plate XII, e). The cocoon is brown and fastened lengthwise to a twig. The moth has a wing-spread of 4-6 inches, is gray and prettily marked with black, red, and creamy-white, with a lunule on each wing. There is only one generation each year, and it passes the winter in the cocoon.

The caterpillar feeds upon spiraea and other plants of the rose family, but is also found upon box-elder and willow.

Hand-picking is perhaps the only remedy needed in Connecticut, but where abundant, the caterpillars may be controlled by spraying with lead arsenate.

(Ohio Bulletin 332, page 266).

EIGHT-SPOTTED FORESTER (*Alypia octomaculata* Fabr.)

The caterpillars of this insect occasionally defoliate Virginia creeper and also feed upon grape, barberry, and rose. They feed in July, and are between one and two inches in length. Their general color is brown with a bluish tinge. Each segment is narrowly banded crosswise with black and white, with a broader band of orange dotted with small black dots. Head and cervical shield are orange with black dots. The moth is black with two round yellow spots on each fore wing and two smaller white spots on each rear wing. The insect passes the winter in the chrysalid stage in the soil, and there is only one annual generation. Caterpillars and moths are shown on Plate XII, b.

Hand-picking and spraying with lead arsenate are the remedies.

(Report for 1916, page 118).

ROSE SAWFLIES (*Caliroa aethiops* Fabr. and others)

Small, greenish slugs often feed upon rose leaves, skeletonizing them. Several species may be involved, one of the most common being named above. This has only one annual generation, but some of the other species probably have more. The adults are four-winged flies, and on account of the toothed ovipositor in the female they are called sawflies.

The larvae or slugs are easily killed by spraying with lead arsenate, with nicotine solution and soap, or fresh hellebore applied as a spray or dust.

(U. S. Farmers' Bulletin 1252).

Honeysuckle Sawflies (*Abia americana* Cress., and *A. inflata* Nort.)

The leaves of various species of bush and climbing honeysuckles are sometimes eaten by the larvae of at least the two species of sawflies named above. In one case the climbing honeysuckle on a wire fence was defoliated. The larvae were grayish-green with orange spots, and presumably there is only one generation each year.

Defoliation may be prevented by spraying with lead arsenate.

Lilac Borer (*Podosesia syringae* Harris)

Lilac and privet are often injured by white grubs burrowing in the stems. Sometimes the stems break over, and in other cases they remain standing and present an unthrifty appearance. The adult is a wasp-like, clear-wing moth of the family Sesiidae, and there is one generation each year. (See Plate XIII, a).

The best means of control is to cut out and burn the infested stems.

(Report for 1905, page 260).

Rose Stem Girdler (*Agrilus viridus* var. *fagi* Ratz.)

Recently an European insect has appeared in Connecticut, called the rose stem girdler, which causes the formation of swellings on the stems of various species and varieties of rose, as shown on Plate XIII, b. *Rosa rugosa* and *R. hugonis* have been noticed with these swellings, which are the result of the plant making an attempt to heal the wounds around the galleries of the larvae.

The adult is a metallic, coppery beetle, about one-third of an inch long, which lays eggs singly on the bark in June and July. The larva is a slender white, flat-headed grub.

The only known remedy is to cut and burn the infested stems in winter or early spring before the beetles emerge.

(Report for 1925, page 325).

Grape-vine Tomato Gall (*Lasioptera vitis* O.S.)

The leaves, peduncles, tendrils, and tender shoots of grape vines are often marked and seriously distorted by irregular water thickenings or swellings which are sometimes red and sometimes green, as shown on Plate XV, b. The adult is a two-winged fly which places its eggs on or in the succulent tissues. The larvae develop in cells in the center of the galls.

The only known method of control is to clip off and burn the infested tips.

(Report for 1916, page 146).

Eriophyid Mites (Family Eriophyidae)

The leaves of shrubs and young trees often exhibit minute galls, usually on the upper surface, caused by mites of the family Eriophyidae. A common form makes elongated pocket galls on the pearl bush, *Exochorda grandiflora*. Other forms are found on elder, birch, maple, and elm. These mites do not seriously affect the vitality of the host but render its appearance unsightly. (Shown on Plate XV, d).

Probably the best control is a dormant spray of liquid lime-sulphur in early spring just before the leaves appear.

Aphids (Family Aphididae). See page 150

Euonymus Scale (*Chionaspis euonymi* Comst.)

Some kinds of Euonymus, as well as bitter-sweet, are infested and seriously injured, even sometimes killed, by this scale. The females are pear-shaped, dark gray, and occur on leaves or tender shoots. The males are smaller, elongate, with parallel margins, and are snowy white. There are said to be two broods each year, the insect passing the winter as eggs under the shells of the mother scale. This scale is shown on Plate XV, a.

The remedies are to prune off and burn the worst-infested stems. The remaining portions may then be sprayed in early April with a miscible oil (1 - 15), or in summer with kerosene emulsion containing 15 per cent or more of kerosene.

(Report for 1921, page 185).

Rose Scale (*Aulacaspis rosae* Bouché)

Rose, blackberry, and some other plants are often infested by a whitish scale, nearly circular, and a little less than one-eighth of an inch in diameter. These are the female scales which, during the winter, cover purple eggs. The male is long and narrow, with three ridges lengthwise, and is also white. This scale is shown on Plate XIV, a.

Cutting and burning the worst-infested stems is recommended; then spray while the plants are dormant, using either liquid lime-sulphur (1 - 9) or a miscible oil (1 - 15).

(Ohio Bulletin 332, page 295).

White Peach Scale (*Aulacaspis pentagona* Targ.-Tozz.)

This has also been called the West Indian peach scale, and though closely related to the rose scale, is much less conspicuous on account of the bark, dirt, and extraneous matter on the shells.

In Connecticut it has been found on cherry, privet, and *Catalpa Bungei,* but is not believed to be an important or serious pest. It is shown on Plate XIV, b.

Spraying with a miscible oil or with lime-sulphur when the plants are dormant is believed to be an effective means of control.

(Report for 1913, page 240).

SAN JOSÉ SCALE. See page 137

INSECT PESTS OF EVERGREEN TREES AND SHRUBS

KEY

A. Chewing insects devouring leaves and buds:

1. Larvae devouring the leaves.................................. 2
   Larvae mining within the leaves.............................. 3
2. Larvae an inch or more in length, white, buff, or green, dotted, striped or mottled with brown or black, feeding gregariously, without webs, on pines..................Pine Sawflies, p. 161
   Larvae one-half inch long, striped lengthwise with light and dark brown, webbing together the twigs of juniper,
   Juniper Webworm, p. 161
3. Minute larvae mining within the leaves of arborvitae,
   Arborvitae Leaf-Miner, p. 161
   Maggots mining within the leaves of box,
   Boxwood Leaf-Miner, p. 162
4. Destroying the terminal buds of pine, causing crooked growth,
   European Pine Shoot Moth, p. 162
   Destroying the terminal buds of spruce....Spruce Budworm, p. 162

B. Attacking roots or stems:

5. Gnawing the bark of the stems of coniferous seedlings,
   Pales Weevil, p. 163
   Gnawing the bark of the roots of hemlock and *Taxus,*
   Otiorhynchid Weevils, p. 163
   Eating off the roots of seedlings.............White Grubs, p. 164
6. Boring in the leaders of white pine, causing them to wilt in July,
   White Pine Weevil, p. 164
   Boring in the stems of rhododendron, Rhododendron Borer, p. 165

C. Sucking juices from leaves or bark:

7. Woolly aphids: wax secretion prominent 8
   Wax secretion slight, forming cone-shaped galls on spruce,
   Spruce Gall Aphids, p. 165
8. Cotton-like tufts of wax in axils of leaves and white patches on bark of white pine.....................Pine Bark Aphid, p. 166
   Cottony wax secretion on leaves of larch,
   Larch Woolly Aphid, p. 166
   Cottony wax secretion on leaves of Douglas fir,
   Douglas-Fir Woolly Aphid, p. 166
9. Elongated white scales on pine leaves......Pine Leaf Scale, p. 166
   Circular scales on leaves of juniper..........Juniper Scale, p. 167
10. Lace-like insects on under side of leaves of rhododendron and *Kalmia*.......................Rhododendron Lace Bug, p. 167
    Red spiders on leaves.........................Spruce Mite, p. 167

PINE SAWFLIES (Family Tenthredinidae)

Different kinds of pine trees are sometimes defoliated by sawfly larvae which usually feed gregariously and are whitish, greenish, or buff, variously dotted or otherwise marked with black or brown. They have the habit of coiling the tail around a leaf as a means of holding on to the food plant. One of the commonest species in nurseries is the imported pine sawfly, *Diprion simile* Hartig. The larvae are slightly more than an inch long, greenish yellow, more or less striped dorsally with brown, and the sides curiously spotted and reticulated, as shown on Plate XIV, c. This species feeds upon the white, Bhotan, Scotch, Austrian, Korean, Mugho, and several other kinds of pines, and there are two full generations each season. Some of the brown cocoons are fastened to the twigs and some are placed upon the ground under the trees. Other species feeding on pine in Connecticut are: *Neodiprion lecontei* Fitch, on white, jack, red, Scotch, Austrian, and Mugho pines; *N. pinetum* Norton, on white pine, and *N. pinus-rigidae* Norton, on pitch pine.

The remedy is to spray with lead arsenate.

(Report for 1915, page 118).

JUNIPER WEBWORM (*Dichomeris marginellus* Fabr.)

Juniper twigs are webbed together by the larvae of this insect, which feeds upon the leaves inside the nest. (See Plate XIV, d). Low juniper in ornamental plantings is often defoliated, but apparently *Juniperus hibernica* is greatly preferred. The caterpillars are about half an inch long, light brown, with longitudinal stripes of darker brown. The adult is a moth with a wing-spread of 15 mm., dark brown, with white front and rear margins on the fore-wings. The larvae pupate in the webs, and the moths appear early in June, but the life history has not been carefully worked out, and it is possible that there is more than one generation each year.

Spraying heavily with lead arsenate is a satisfactory remedy.

(Report for 1915, page 137).

ARBORVITAE LEAF-MINER (*Argyresthia thuiella* Pack.)

Small larvae mining in the leaves often give a brown or dead appearance to arborvitae. (See Plate XVI, b). The adult is a tiny moth which lays eggs on the leaves in June. There is one annual generation, and the insect spends the winter in the cocoon in the mine.

Though remedial measures are of somewhat questionable value, it is thought that a heavy application of nicotine solution and soap or of fish-oil emulsion may kill some of the eggs or larvae and thus prevent severe injury to the foliage by the insects.

(Report for 1921, page 157).

Boxwood Leaf Miner (*Monarthropalpus buxi* Labou)

The adult of this insect is a yellow midge or two-winged fly which lays eggs in the leaves in May, and the maggots feed and develop between the upper and lower epidermal layers, causing a blistering and distortion of the leaves, often called galls. (Shown on Plate XVI, a). The foliage is usually thin on infested plants. The maggots live over winter in the leaves and pupate in spring.

The remedy is to spray the plants with a cheap molasses, one part in four parts of water, with the addition of nicotine sulphate, one part in 500 parts of the spray material. The first application should be made when the adults first begin to emerge from the infested leaves, and the plants should be kept covered for three weeks. One application each week will answer in fair weather, but the plants should be sprayed after each rain.

(Report for 1923, page 312; Maryland Bulletin 272).

European Pine Shoot Moth (*Rhyacionia* (*Evetria*) *buoliana* Schiff.)

This is a serious pest of all kinds of pines in Europe and is now present in Fairfield County, Connecticut, where it seems to prefer the red pine. The adult is a small orange moth which in August lays eggs singly on the newly formed terminal buds which are ready for next year's growth. The young larvae soon eat their way into the buds and excavate cells in which they spend the winter. The following spring the larva leaves its winter home and bores into the next bud, and thus destroys as many buds as may be needed for food. It also attacks the young shoots, feeding on one side, causing them to become curved and deformed. When mature, the larva pupates in an excavated shoot, and three weeks later the moth emerges. Apparently there is only one generation each year. Distorted and crooked growth called "bayonet shoots" follows the attack of this insect.

No remedy is known other than to prune and burn the infested buds and shoots.

(U. S. D. A. Bulletin 170).

Spruce Budworm (*Harmologa fumiferana* Clem.)

Spruce and balsam trees are often severely injured by this insect. The moths emerge in June and July and the females lay upon the needles their eggs, which hatch in ten days, but the larvae do little or no feeding until the following spring. They pass the winter in protective cases which they spin in crevices on the tree or other convenient shelters. The young caterpillars feed for about three weeks in the spring at the base of needles upon the terminal shoots, moving about freely. The severed needles are

loosely attached to the twigs by the silk threads spun by the larvae. When fully grown each larva is about three-fourths of an inch long, and it then pupates upon the tree. The adult moth is gray with brown markings and white spots. There is only one annual generation.

Spraying heavily with lead arsenate will doubtless prove effective in the nursery and on small ornamental trees.

(Manual of Tree and Shrub Insects, page 285).

Pales Weevil (*Hylobius pales* Herbst)

This insect is a Curculionid or snout beetle less than half an inch in length. In color it varies from dark reddish-brown to black, and usually has gray or whitish hairs so arranged as to form small spots on the wing-covers. This beetle is believed to be responsible for the failure of much of the forest planting where conifers are used and has also injured seedlings in nurseries by eating off the bark of the stems, thus in effect girdling the young trees. Nearly all kinds of coniferous trees are attacked, and the feeding is done at night. There is only one generation each year, and the beetles hibernate in the soil at the base of the trees. The eggs are laid and the larvae feed in pine stumps and logs.

As a control measure, seedlings or nursery stock should not be grown in close proximity to pine logs, stumps, or lumber.

(Harvard Forest Bulletin 3).

Otiorhynchid Weevils (*Otiorhynchus sulcatus* Fabr. and *O. ovatus* Linn.)

Taxus plants are occasionally injured in nurseries by the grubs or larvae of *Otiorhynchus sulcatus* Fabr., a black snout beetle with faint gray spots, half an inch in length, commonly called the black vine weevil, and shown on Plate XVIII, b.

A case of injury occurred in a nursery in 1913: The smaller roots had been devoured, and the larger ones and the main stem had been girdled. In 1909, hemlock trees from 12 to 18 inches tall showed signs of unthriftiness, failed to grow, and some of them dropped their leaves. At the roots were grubs, pupae, and adults of *Otiorhynchus ovatus,* commonly known as the strawberry crown girdler. This species is about one-fourth of an inch long and is brown without color markings. This smaller species had girdled the main stem and larger roots.

Treating the soil with an emulsion of carbon disulphide, as is done to kill the grubs of the Japanese beetle and the Asiatic beetle, may be recommended in severe infestations.

(Report for 1909, page 370; 1913, page 230).

WHITE GRUBS (*Phyllophaga* or *Lachnosterna* sps.)

The larvae of May or June beetles occasionally eat off the roots of coniferous trees in nurseries. There are probably several species involved, and most of them require three years to complete the life cycle. The injury is usually the most severe the third season, when the grubs are large and voracious. Shown in Figs. 30 and 31.

In some cases it may be possible to treat the soil about the plants with an emulsion of carbon disulphide.

(Report for 1912, page 288).

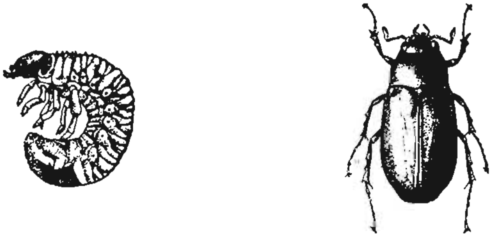


FIG. 30. White grub and its adult, the common June beetle.

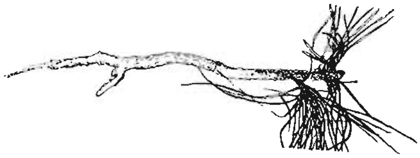


FIG. 31. Pine seedling with roots eaten off by white grubs.

WHITE PINE WEEVIL (*Pissodes strobi* Peck)

The white pine weevil probably causes more injury to white pine trees in Connecticut than any other insect, and perhaps more than all other insects together. It also injures spruce trees. There is one annual generation, and the beetles hibernate somewhere during the winter and appear on the pine trees about May 1. They make punctures in the bark of the leaders or terminal shoots of the preceding season's growth. In some of these punctures eggs are laid and soon hatch. The grubs feed in the cambium and sometimes in the pith, becoming mature in about six weeks, when they excavate cells in the wood in which they pupate. Late in July and continuing until September, the adult beetles emerge. The infested leaders wilt in July and later turn brown and die. In time a lateral branch will grow upright and take the place of

the leader, but this makes crooked and ill-shaped trees. The injury caused by this insect is shown in Fig. 32 and on Plate XVIII, c.

Trees may be partially protected by spraying the leaders about May 1 with either lead arsenate or liquid lime-sulphur (1 - 9).

(Report for 1919, page 144).

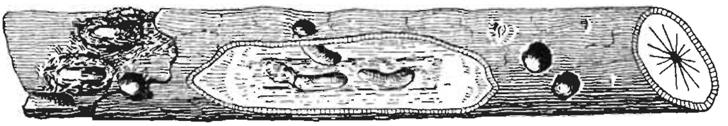


FIG. 32. Pupal cases, larval cells, and exit holes of the white pine weevil. About twice natural size.

RHODODENDRON BORER (*Sesia rhododendri* Beut.)

Serious injury to rhododendrons in ornamental plantings has been caused by the rhododendron borer in Connecticut, though the work of the insect has not been very noticeable in nurseries. The adult is a wasp-like clear-wing moth which lays eggs in late May or June on the twigs. The larva soon after hatching tunnels into the sapwood of the stem, where it forms irregular galleries from one to two inches long, usually just below a crotch. Larvae are yellowish-white, about half an inch long, and usually become full grown by October but remain in their galleries through the winter and pupate there in the spring. Two weeks later the moths appear, and there is only one annual generation.

The injured stems cannot supply the necessary moisture and the leaves turn brown and die. The stems are often broken at the point of injury. *Rhododendron maximum* is perhaps more severely injured than other species, but hybrid rhododendrons are also attacked. The injury is shown on Plate XVII, a.

There is no remedy except to cut out the borers and to prune off and burn infested stems and branches.

(Report for 1922, page 347).

SPRUCE GALL APHIDS (*Adelges, Chermes,* sps.)

One of the commonest pests in nurseries is the spruce gall aphid, *Adelges abietis* Linn., which forms cone-shaped galls at the base of the new growth on Norway spruce, and sometimes black, red, and white spruce trees are infested to a less extent. There are two broods each season, the winter being passed by the immature females on the twigs. They reach maturity and lay on the leaves masses of eggs which hatch soon after the new shoots appear in May. The young aphids crawl to the base of the shoots and at-

tach themselves where the irritation resulting from their feeding causes the needles to swell at the base until they touch each other. Thus pockets are formed in which the young aphids are enclosed, and the result is one continuous gall, shaped like the cone of the tree. These galls break open in August, and the aphids go to the leaves and soon transform to mature females which lay eggs for the second brood. One of the galls is shown on Plate XVII, c.

Larger terminal galls on the Colorado blue spruce are formed by *Gillettea cooleyi* Gill., (see Plate XVII, b), and a form known as variety *coweni* Gill. is the woolly aphid common upon the leaves of Douglas fir. Another species, *Adelges (Chermes) strobilobius*, is known as the larch woolly aphid, and is common on larch foliage in midsummer.

The remedy is to spray the trees early in April with a miscible oil (1 - 25), to kill the overwintering females. The summer forms on leaves may be killed by spraying with nicotine solution and soap.

(Report for 1926, page 223).

Pine Bark Aphid [*Adelges (Chermes) pinicorticis* Fitch]

Small, cotton-like tufts of wax in the axils of the leaf clusters are common on small white pine trees, and on larger ones large whitepatches on the bark are often seen. The pine bark aphid is the cause, but its life history is not fully known. Eggs hatch about May 1, and the young settle along the twigs and suck the sap from the bark, soon becoming covered with slender filaments of wax, giving them the appearance of small tufts of cotton, as shown on Plate XVIII, a.

Trees can be entirely cleared of this insect by a thorough spraying in June with kerosene emulsion, and probably nicotine solution and soap will prove equally effective.

(Report for 1919, page 155).

Pine Leaf Scale (*Chionaspis pinifoliae* Fitch)

Often small pine trees show elongated white scales on the leaves. This is the pine leaf scale which infests Mugho, Austrian, jack, red, Scotch, stone, and white pines, sometimes killing them. There are two generations each year, and purple eggs under the female shells carry the species through the winter. These eggs begin to hatch in May, but the hatching period is a long one, and the two broods are not distinct but overlap.

Illustrations of this scale are shown on Plate XV, c.

Control measures for this insect have not been given a thorough trial in Connecticut, but it can doubtless be held in check by dor-

mant spray applications of liquid lime-sulphur (1 - 9), or of miscible oil (1 - 15) in April, and of nicotine solution and soap between June 1 and August 1.

(Report for 1921, page 181).

Juniper Scale (*Diaspis carueli* Targ.-Tozz.)

Small, circular, whitish scales 1-2 mm. in diameter are often present and sometimes very abundant on the leaves of juniper, resulting in a yellow and sickly appearance.

Spraying with a miscible oil (1 - 25) in spring, before the new growth starts, will probably control this insect.

(Report for 1920, page 212).

Rhododendron Lace Bug (*Leptobyrsa rhododendri* Horvath)

This is a sucking bug belonging to the family Tingidae and commonly called lace bug. It is on the under side of the leaves of rhododendron, especially *R. maxima,* and *Kalmia latifolia* or mountain laurel. Apparently there is only one brood each year. The eggs are laid along the midrib, and there is much brownish discoloration from the excrement. The injured leaves show whitish spots on the upper surface. (See Plate XX, d).

Spraying the under sides of the leaves with nicotine solution and soap when the bugs are present has been effective.

(Report for 1921, page 200).

Spruce Mite (*Paratetranychus ununguis* Jacobi)

Spruce trees and other evergreens are often severely injured by mites. Such injury is noticed somewhere in the State each year, though it is usually more severe and more widespread in seasons of drought. The leaves are peppered with small whitish spots, covered with brownish eggs and egg-shells, and are usually more or less webbed together. The greenish-yellow living mites and their cast skins are also abundant.

Spraying in spring before the new growth starts with a miscible oil (1 - 15) to kill the eggs, and the application of liquid lime-sulphur (1 - 50) or linseed oil emulsion to kill the mites in midsummer, are recommended. Some of the oil preparations are apt to remove the bloom from some of the varieties of blue spruce.

(Report for 1922, page 340).

INSECTS INJURING PERENNIAL PLANTS

Key

A. Chewing Insects:

1. Attacking the leaves 2
   Attacking the stem or root 5
2. Devouring the leaves 3
   Mining within the leaves of columbine, Columbine Leaf-Miner, p. 168
3. Perforating or devouring portions of the entire thickness of the leaves 4
   Minute jumping insects feeding on surface of leaves of seedlings, Garden Spring-Tail, p. 169
4. Feeding at night, hiding during the day:
   Larvae with true legs, curled up in soil around base of plant, Climbing Cutworms, p. 130
   Gray or brown slugs without legs, hiding under rubbish and leaving a slimy trail .... Garden Slugs, p. 170
5. Cutting off the stem near the surface of the ground:
   Larvae curled up in soil near the plant .... Cutworms, p. 169
   Striped larva boring lengthwise in stem .... Stalk Borer, p. 170
   Pink larva burrowing in rootstocks of iris .. Iris Root Borer, p. 171

B. Sucking Insects:

6. Visible insects attacking leaves or shoots at tip 7
   Reddish mites with eggs and shells injuring leaf surface, Red Spider, p. 150
   Microscopic, glassy mites, curling leaves of larkspur and some other plants .... Cyclamen Mite, p. 172
7. Exceedingly active flying bugs, with nymphs on leaves 8
   Rather inactive plant-lice on leaves or stems .... Aphids, p. 150
8. Greenish-yellow bugs; adult with four black stripes, on terminal leaves .... Four-lined Plant Bug, p. 172
   Grayish or brownish bugs on terminal leaves, Tarnished Plant Bug, p. 139

Columbine Leaf-Miner (*Phytomyza aquilegiae* Hardy)

In June, whitish serpentine mines begin to appear in the lower leaves of columbine. There are often several miners in a leaf, and the mines may continue to increase in size until the entire leaf is involved. Later the small leaves around the flower stalks are infested. There are several generations, the winter being passed as pupae in the ground. The eggs are laid in the under sides of the leaves and hatch in less than a week. The larvae mine between the upper and lower epidermal layers of the leaf, becoming mature in about two weeks, and emerge from the mines through crescent-shaped openings. They attach themselves to the leaf and pupate. In two weeks the adults emerge. They are small, dark brown flies about 2 mm. long. Injured leaves are shown on Plate XX, a.

Cultivating the ground around the plants in late fall or early spring will reduce the infestation. Removing and destroying the mined leaves when the infestation first appears will aid in the control of this pest.

(Report for 1894, page 145; New Jersey Department of Agriculture, Circular 36, page 13).

Garden Spring-Tail (*Sminthurus hortensis* Fitch)

Small seedling plants, particularly in hotbeds or cold frames, are often injured in early spring by minute, purplish, jumping insects which eat off the surface tissue from the leaves. These tiny insects are purple, spotted with yellow, and jump like fleas. Each has a globular-shaped body and rather large head with narrow neck. A forked tail-like appendage used in jumping extends rearward from the under side of the body, as shown in Fig. 33.

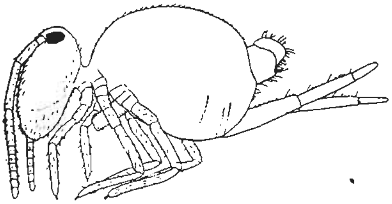


Fig. 33. Garden spring-tail.

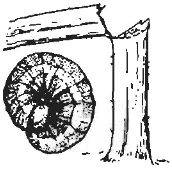


Fig. 34. Cutworm and characteristic injury to plant.

This insect may be controlled by spraying or dusting the plants with nicotine.

(Bulletin 6, Tobacco Experiment Station, page 86 T).

Cutworms (Noctuidae, several species)

Perennial plants, especially the seedlings and tender shoots, are often cut off near the ground by cutworms, as shown in Fig. 34. There are also other kinds of cutworms which climb and feed upon the leaves. Most of the cutworms are single-brooded and live through the winter as partially grown larvae. The adult moths emerge and lay their eggs in late summer. All cutworms are the larvae of rather inconspicuous gray or brown moths of the family Noctuidae, and there are perhaps a dozen or more species that are classed as cutworms.

Injury from the climbing cutworms may be lessened by spraying the foliage with lead arsenate. The cutworms, which cut off the

stems of plants, can best be controlled with a poisoned bait distributed about the field a few days before the injury becomes serious. A formula for this bait is as follows:

Wheat bran	5 lbs.
White arsenic or Paris Green	4 oz.
Cheap molasses	1 pint
Orange or lemon	1 fruit
Water	7 pints

Cut the fruit into small pieces and mix together to form a rather dry mash and scatter around the field.

Garden Slugs (Family Limacidae)

The leaves of garden plants are often eaten by slugs, which are closely related to snails but without the usual shell. One of the commonest species is the gray field slug, *Agriolimax agrestis* Linn., and another and more striking species is the giant or spotted garden slug, *Limax maximus* Linn., shown in Fig. 35.

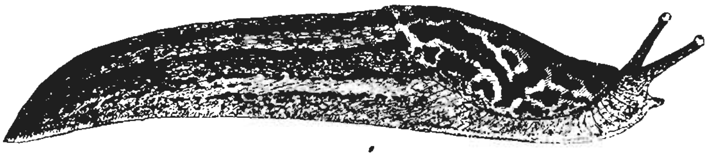


Fig. 35. Spotted garden slug, natural size. (After Kingsley, Riverside Natural History).

These animals feed at night on the tender leaves of garden and greenhouse plants, eating holes through the leaves or notches in the margins. They hide under rubbish during the day and leave a slimy trail wherever they crawl.

Plants may be protected by spraying or dusting with lead arsenate. As a rule, beds may be protected by surrounding them with a layer of air-slaked lime, but fine soot or coal ashes will answer the purpose, as the slugs do not like to crawl through such dry material.

(Report for 1918, page 333).

Stalk Borer (*Papaipema nebris* Guen.)

The stalk borer may be found in any kind of herbaceous stem and attacks vegetables, annual and perennial flowering plants, and weeds. (See Fig. 36). Among the perennials it is often found in hollyhock, lily, larkspur, peony, and chrysanthemum. There is a single generation each year, and the insect passes the winter as an egg on the stem of dead grass. The eggs hatch in May and the

larvae begin to tunnel in grass stems, later migrating to other plants. By August or early September, the larvae mature and pupate in the burrows; a month later the adults emerge. The moth has a wing-spread of about one and three-eighths inches and is brown, with conspicuous white discal spots on the fore wings. Larva and adult are shown on Plate XX, b and c.

Heretofore the only remedy has been to cut out the borer, burn the infested stalks, or inject carbon disulphide into the burrow and plug the opening. Burning the grass and weeds around the fields

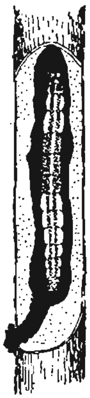


FIG. 36. Stalk borer.

in late fall or early spring is now known to have a tendency to reduce the number of stalk borers by killing the eggs.

(Report for 1919, page 180. New Hampshire Technical Bulletin 34).

IRIS ROOT BORER (*Macronoctua onusta* Grote)

The rootstocks of iris plants are injured by a pink larva tunneling in them, often devouring the entire rootstock and killing the plant. This is the larva of a brown moth with a wing-spread of about two inches, which probably has only one generation each year. The adults emerge in September or October and lay eggs upon the iris leaves. These eggs hatch in spring, and the young borers find their way into the rootstock, where they feed and increase in size, becoming fully grown in August. They then pupate in the ground, and later the adults emerge. Larva and moth are shown on Plate XIX, b and c.

Gathering and burning the leaves in late fall or early spring to destroy the eggs is the only remedy known.

(Report for 1918, page 331).

RED SPIDER (*Tetranychus bimaculatus* Harv.) See page 150

CYCLAMEN MITE (*Tarsonemus pallidus* Banks)

This mite often injures larkspur and several annual plants in the garden, as well as cyclamen, snapdragon, and chrysanthemum in the greenhouse. The new leaves become thickened and more or less curled, as shown on Plate XIX, a. Buds are also distorted and fail to open properly. The mites are almost too small to be seen by the naked eye, but under the magnifying glass they are white and glassy.

Frequent and thorough spraying with nicotine solution and soap, one part in 500 parts of water, if started when the injury first appears, will control this pest. This treatment should be repeated each week and, in severe cases, twice each week.

(Report for 1914, page 176).

APHIDS (Family Aphididae). See page 150

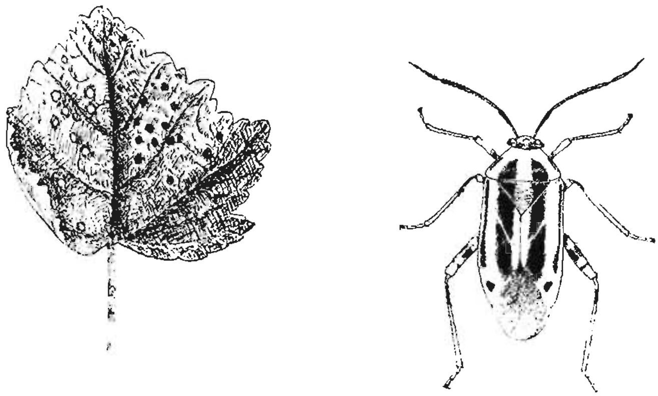


FIG. 37. Four-lined plant bug and injured currant leaf.

FOUR-LINED PLANT BUG (*Poecilocapsus lineatus* Fabr.)

This greenish-yellow bug is about three-eighths of an inch long in the adult stage and has four black stripes on its back. In early spring when first hatched, it is bright red, with large black spots on the thorax. The eggs are laid by the adult bugs late in June or early July, but do not hatch until the following spring. The young nymphs feed for about three weeks and reach the adult or winged stage about the middle of June. There is but one generation each year. This insect has a wide range of food plants, being particularly injurious to dahlia, rose, currant, gooseberry, and mint.

It gets its nourishment by sucking the juices from the tenderest leaves near the ends of the shoots. The injured leaves turn brown in spots, which later become transparent, and in heavy infestations the entire leaf turns brown. (See Fig. 37).

The adults are shy and very active when alarmed and very difficult to capture. As they fly readily, they are not easily killed by sprays. The nymph, having no wings, may be killed by a spray of nicotine and soap, and some of the adults will likewise be hit and killed.

(Report for 1914, page 189).

TARNISHED PLANT BUG (*Lygus pratensis* Linn.) See page 139

PLATE I.

. Adult female and egg-mass of fall cankerworm. Twice natural size.

b. Egg-mass of fall cankerworm on twig. Four times enlarged.

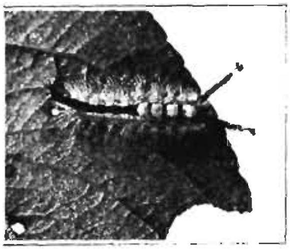
Apple leaf partly devoured by cankerworms.

d. Leopard moth larva in its burrow. Natural size.

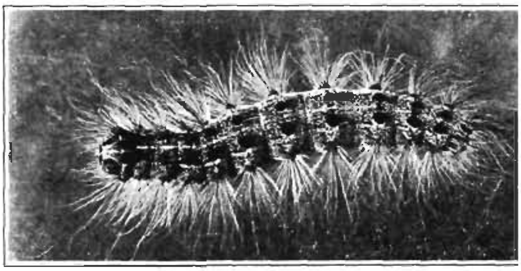
PLATE II.

a. Nests of fall web-worm. (After Slingerland).

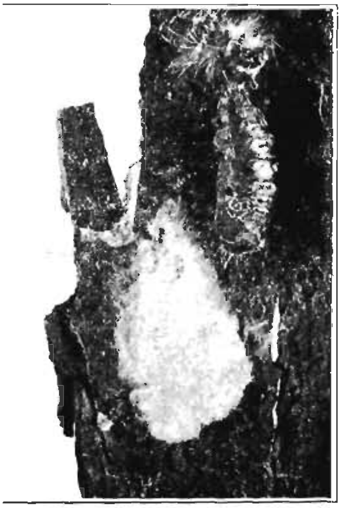
b. Hickory tussock moth. Fully grown caterpillar on leaf. Natural size.



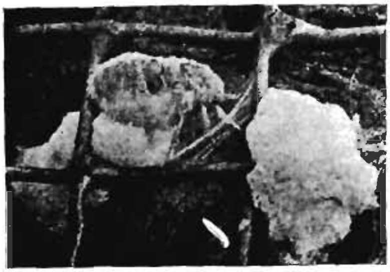
White-marked tussock moth caterpillar. Natural size.



d. Gipsy moth caterpillar. Natural size.

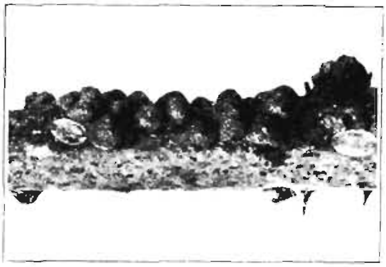


Gipsy moth egg-mass and pupa. Natural size.



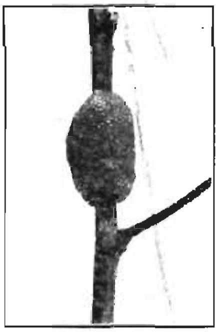
f. White-marked tussock moth. Natural size. Female moth and egg-masses.

a. Oyster-shell scale on poplar. Natural size.

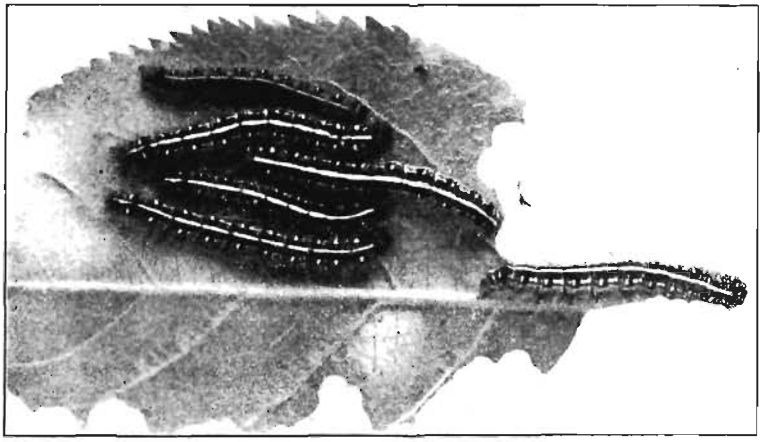


b. European fruit lecanium on blackberry. Natural size.

c. Nest of tent caterpillar.

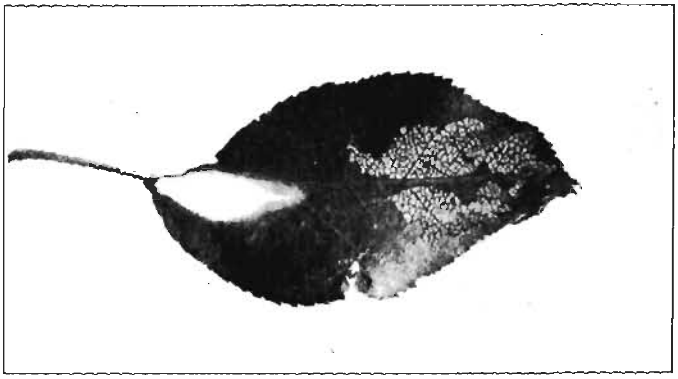


d. Egg-mass of tent caterpillar on twig. Natural size.

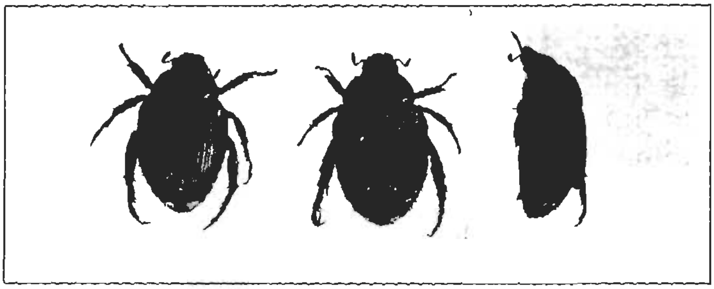


e. Tent caterpillars, partially grown. Natural size.

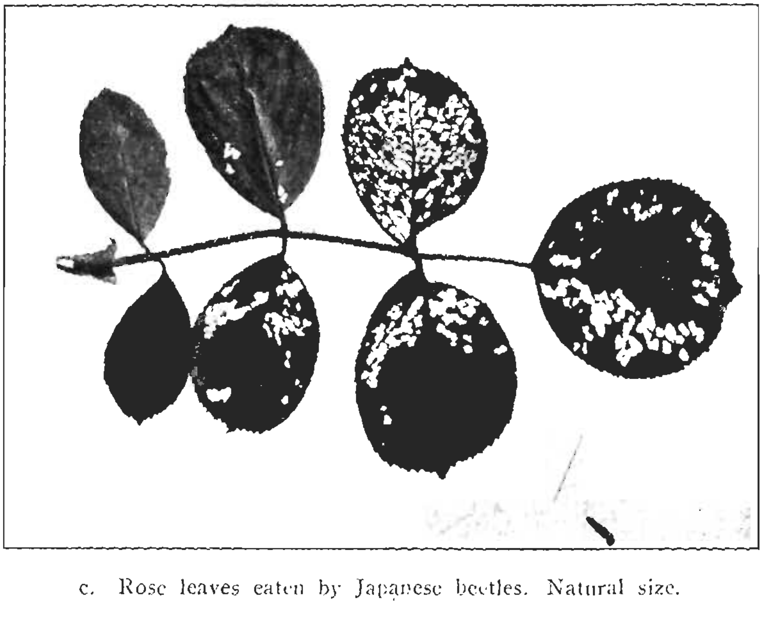
PLATE IV.



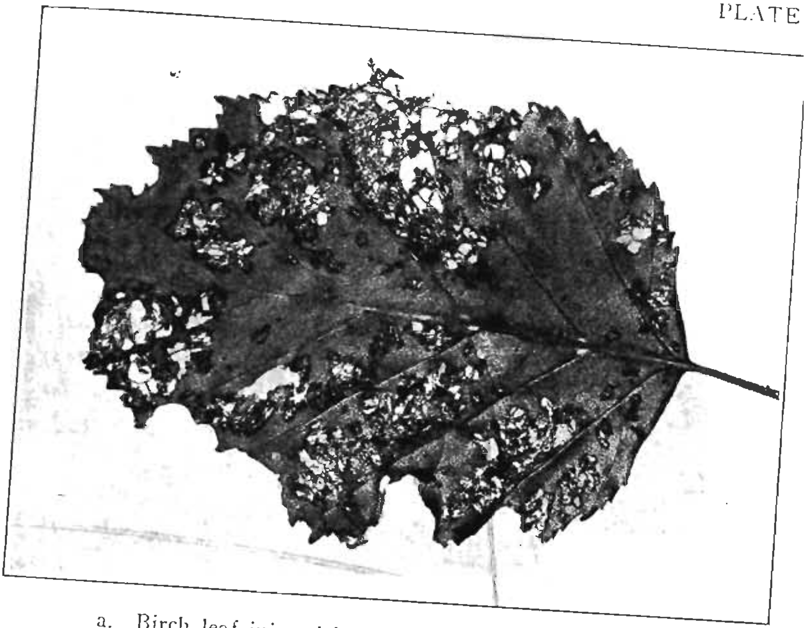
a. Apple and thorn skeletonizer: apple leaf eaten by caterpillar, and cocoon. Somewhat reduced.



b. Japanese beetle; adults twice enlarged.

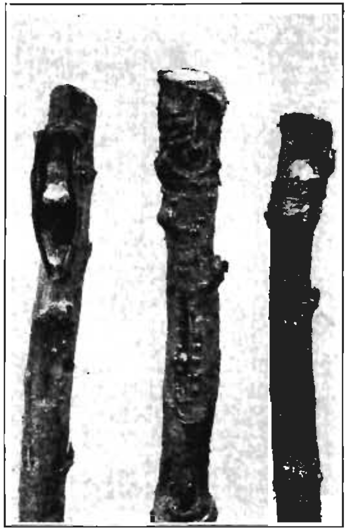


c. Rose leaves eaten by Japanese beetles. Natural size.



a. Birch leaf injured by the rose chafer. Natural size.

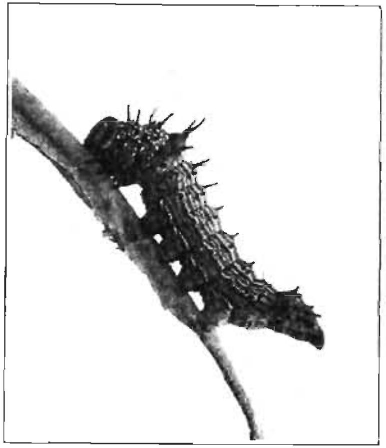
Peach twigs injured by larvae of the Oriental peach moth. Natural size.



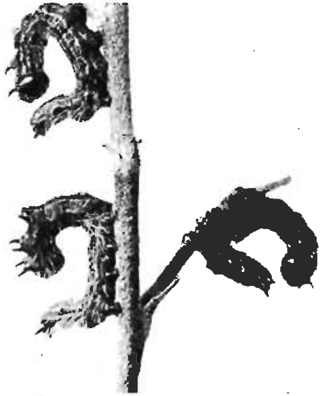
c. Budded fruit trees, showing where buds were destroyed by climbing cutworms. Natural size.

d. Peach borer in base of young tree.

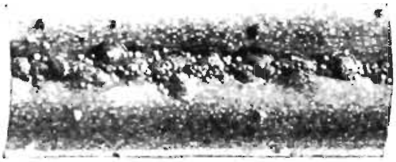
PLATE VI.



a. Red-humped caterpillar. Enlarged one and one-half times.



b. Yellow-necked caterpillars. Natural size.



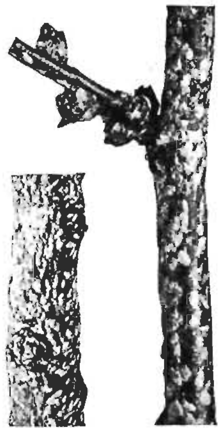
a. San José scale on peach twig. Twice natural size.

b. Green aphids on apple leaf. Natural size.

c. Woolly aphids on twigs, showing galls and white flocculent appearance.

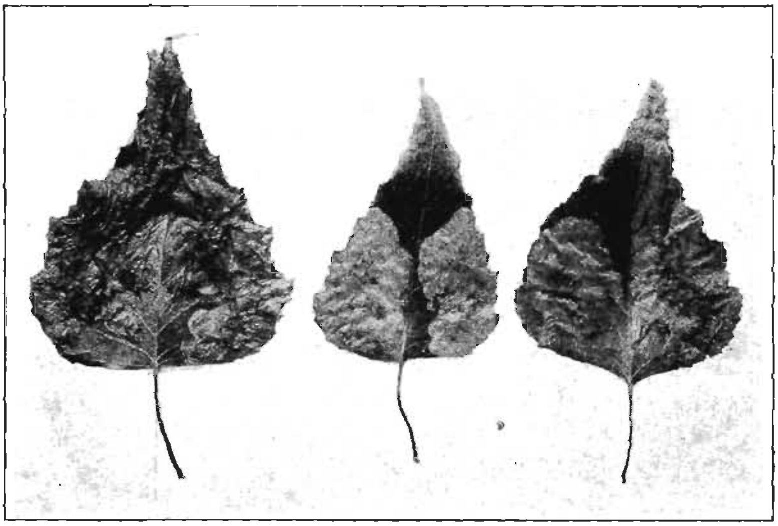
d. Eggs of European red mite. Ten times enlarged.

e. Leaf showing work of pear leaf blister mite. Natural size.

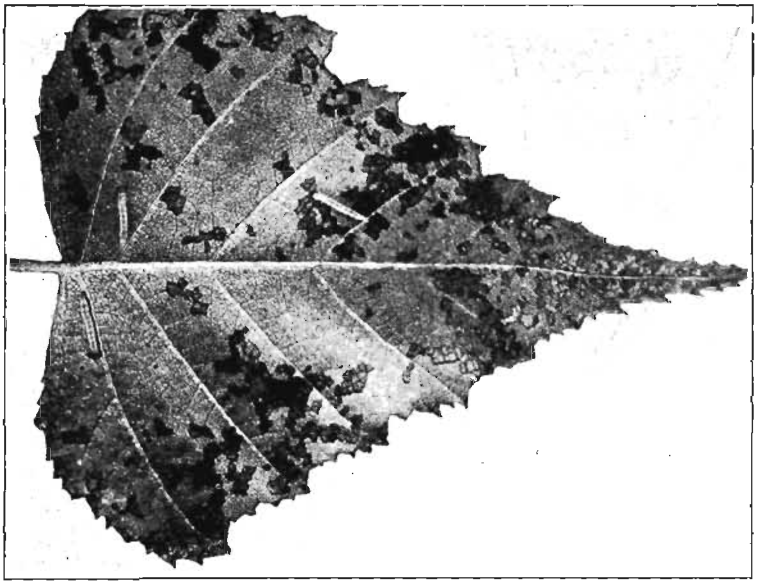


f. Scurfy scale on currant; males at left: females at right.

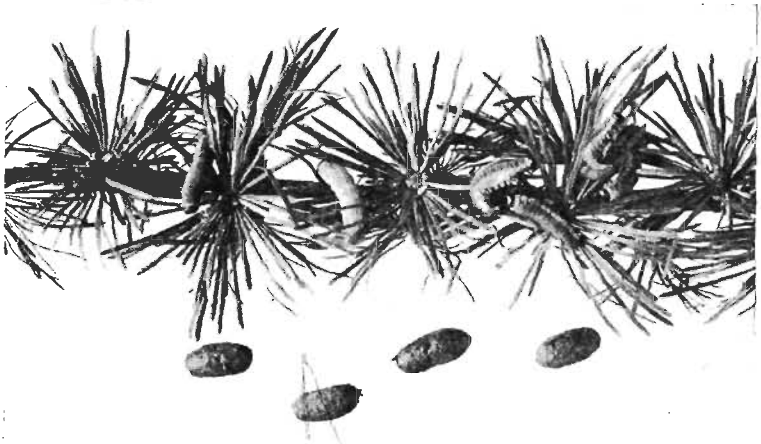
PLATE VIII.



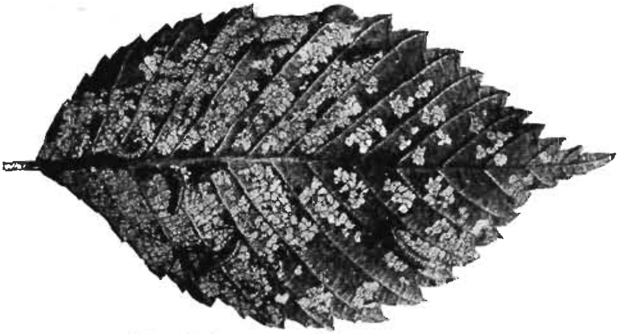
a. Leaves of gray birch injured by the imported birch leaf miner.



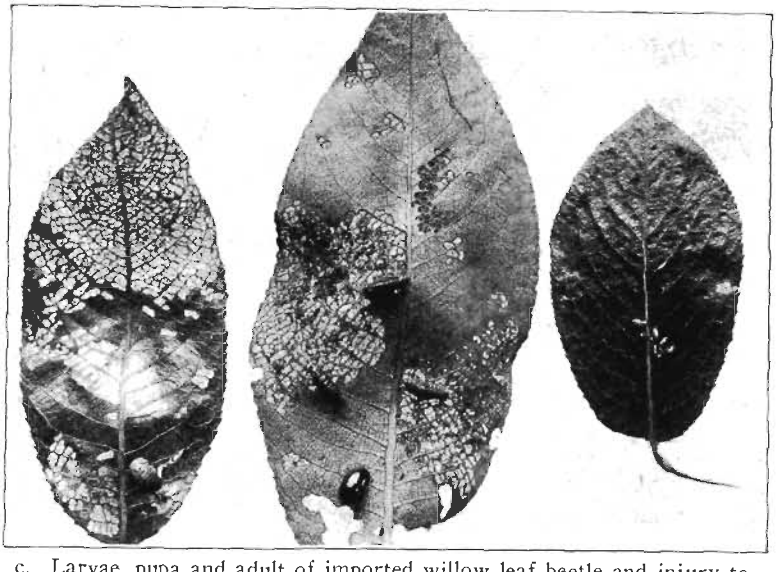
b. Larvae of birch skeletonizer on leaf of gray birch. Slightly enlarged.



a. Larvae and pupae of the larch sawfly. Natural size.

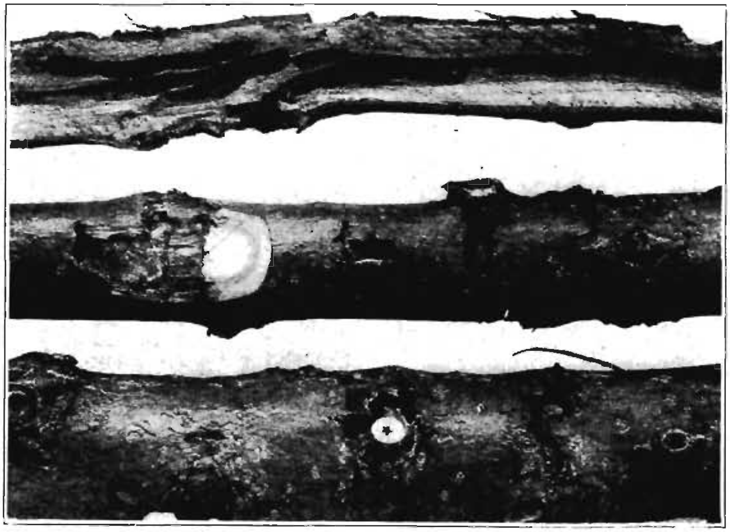


b. Elm leaf beetle larvae and their work. Natural size.

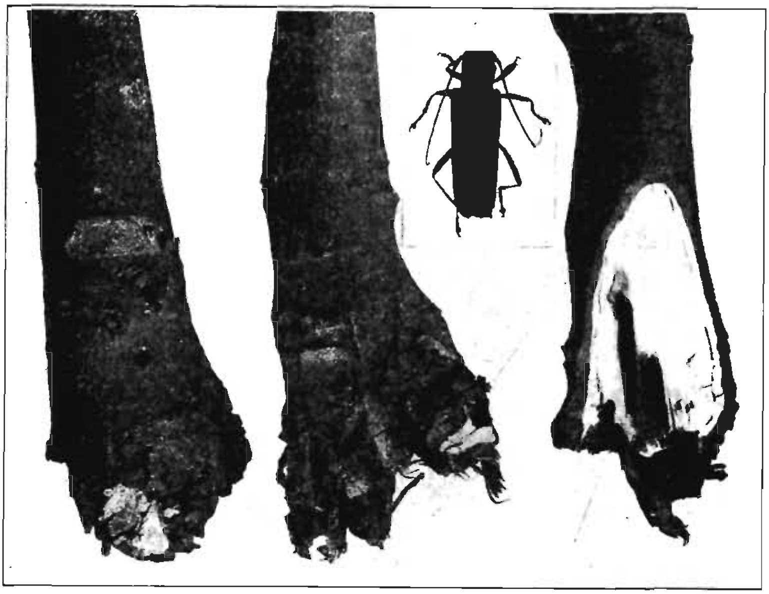


c. Larvae, pupa and adult of imported willow leaf beetle and injury to willow leaves. Slightly enlarged.

PLATE X.



a. Work of poplar and willow borer. Natural size.



b. Linden borer, natural size, and its injury to young linden trees, greatly reduced.

a. European elm scale. Natural size.

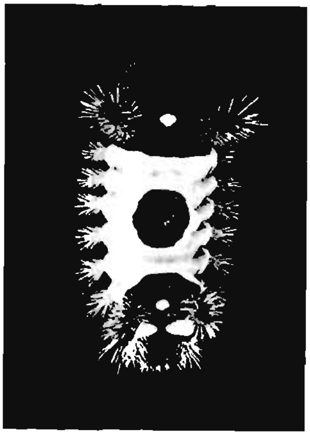
b. Terrapin scale. Natural size.

c. Pit-making oak scale. Natural size.

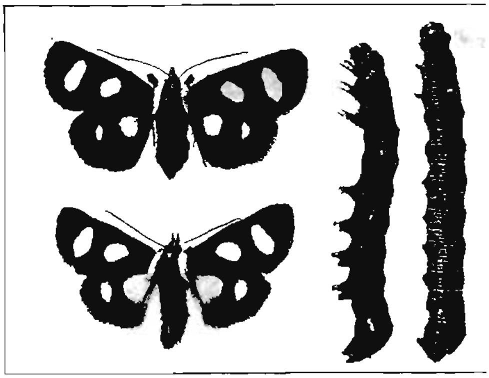
d. Tulip tree scale. Natural size.

e. Cottony maple scale. Natural size.

PLATE XII.

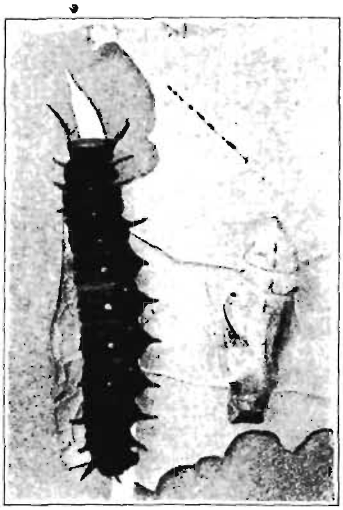


a. Saddle-back caterpillar. Twice enlarged.

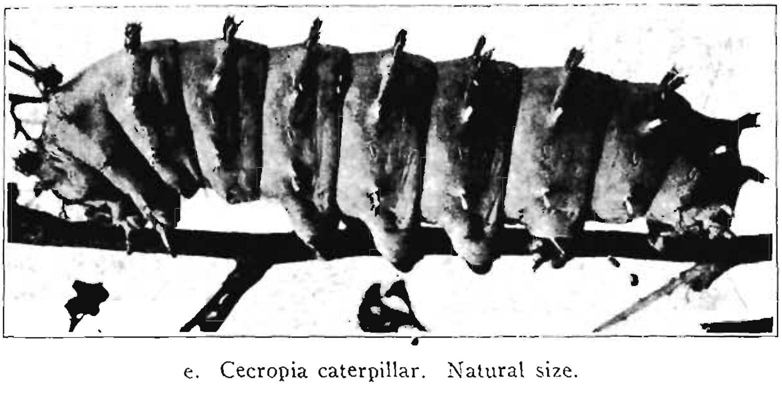


b. Eight-spotted forester. Adults and larvæ natural size.

c. Io caterpillars. Natural size.

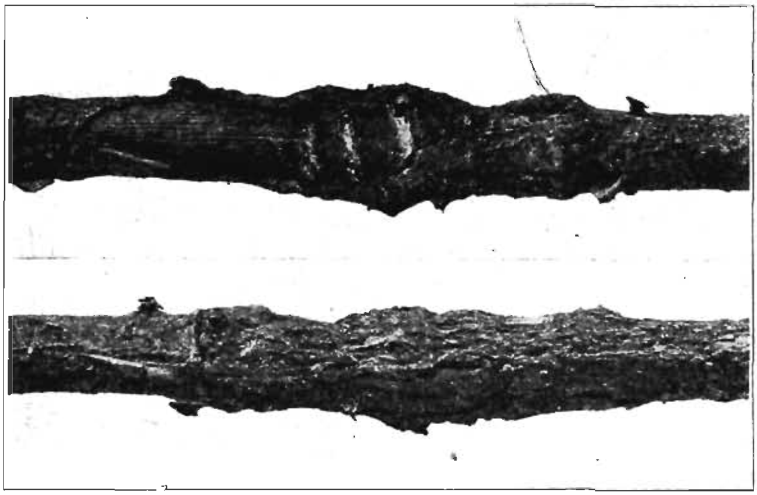


d. Pipe-vine caterpillar. Natural size.



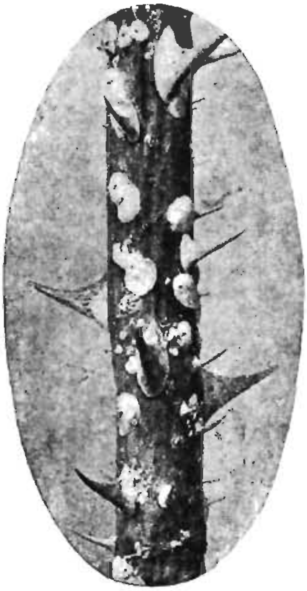
e. Cecropia caterpillar. Natural size.

a. Lilac borer, showing adult pupa case and injured privet stem. Natural size.



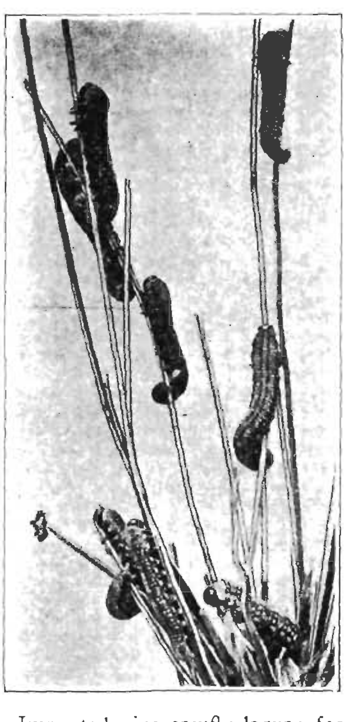
b. Galls of rose stem girdler, twice enlarged.

PLATE XIV.



a. Rose scale, twice enlarged.

b. White peach scale, twice enlarged.



. Imported pine sawfly larvae feeding on leaves. Natural size.

d. Work of juniper webworm.

PLATE XV.

a. Euonymus scale, mostly males. A few larger, gray females are present.

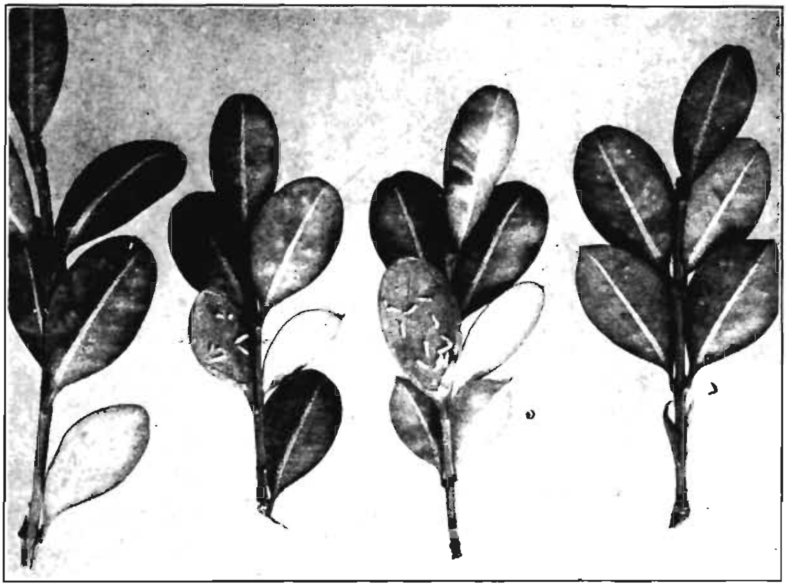
b. Grape-vine tomato gall.

c. Pine leaf scale, twice enlarged.

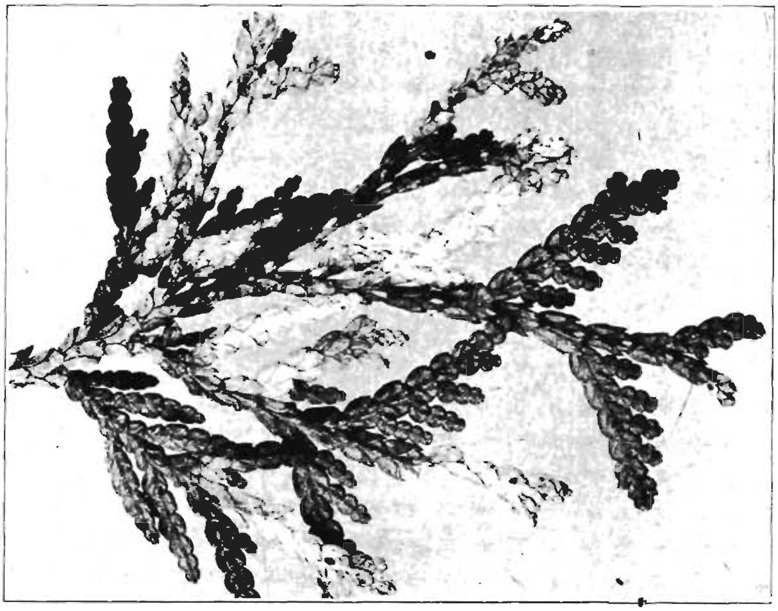
d. Mite galls on leaves of Exochorda.

e. Oak gall scale.

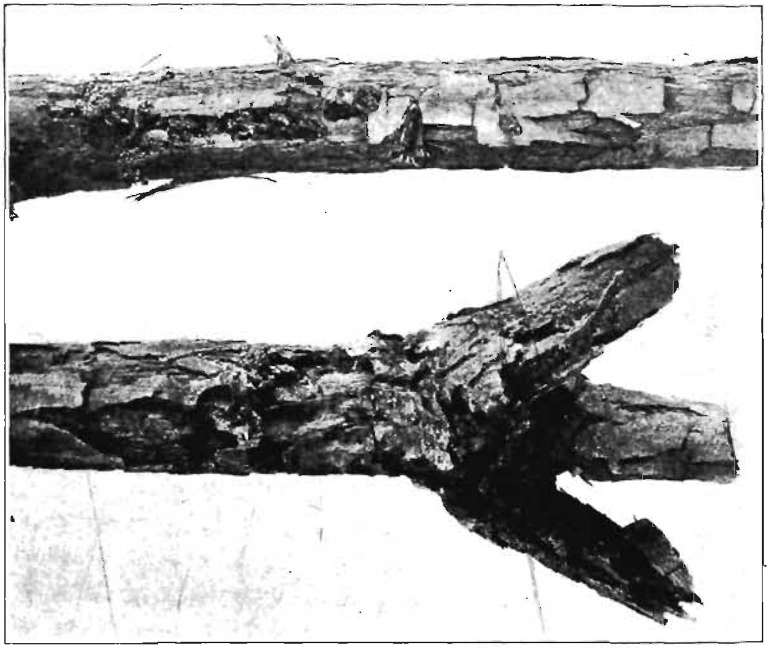
PLATE XVI



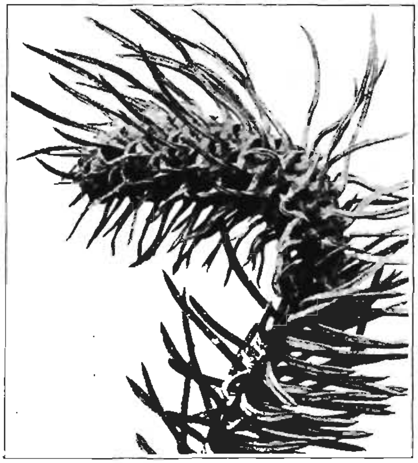
a. Boxwood leaf miner. White spots on leaves indicate infestation. Lower epidermis has been removed from two leaves, showing maggots. Natural size.



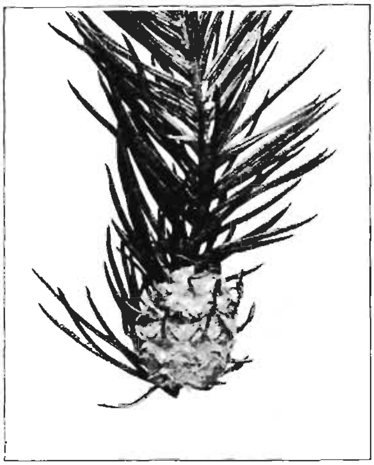
b. Work of arborvitae leaf miner, twice enlarged.



a Rhododendron borer. Appearance of infested stems showing adult. Natural size.

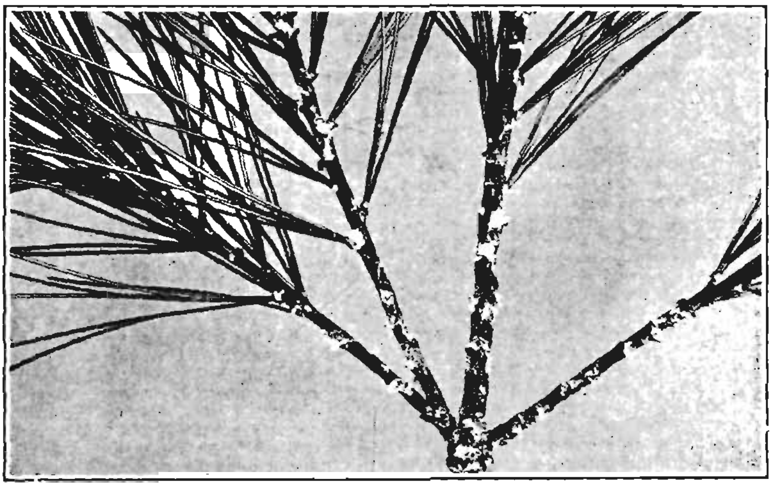


b. Gall of blue spruce. Natural size.

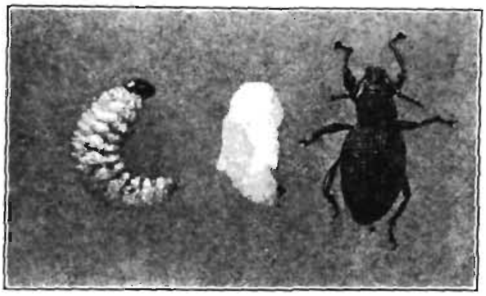


c. Spruce gall. Natural size.

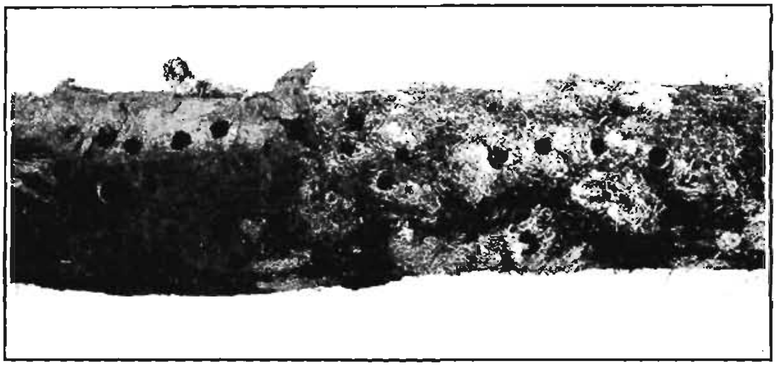
PLATE XVIII.



a. Pine bark aphid in small tufts on twigs and leaves. Natural size.



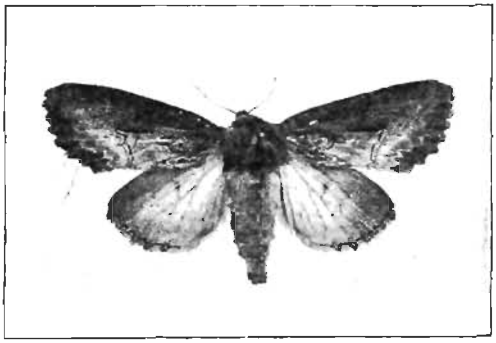
b. *Otiorhynchus sulcatus* Fabr. Larva, pupa, and adult. Twice enlarged.



c. Exit holes of white pine weevil. Natural size.

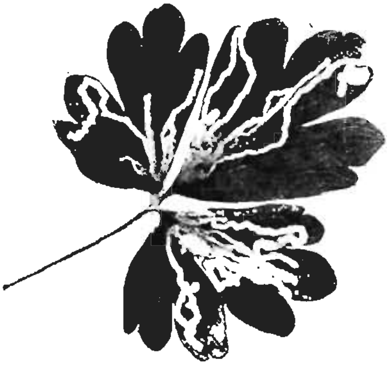
PLATE XIX.

a. Larkspur leaves curled by cyclamen mites; healthy leaf at left. Somewhat reduced.

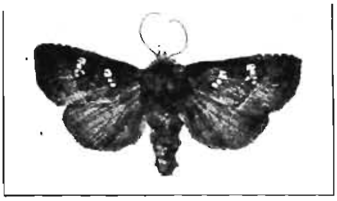


b. Adult of iris root borer. Natural size.

c. Iris root borer. Natural size.

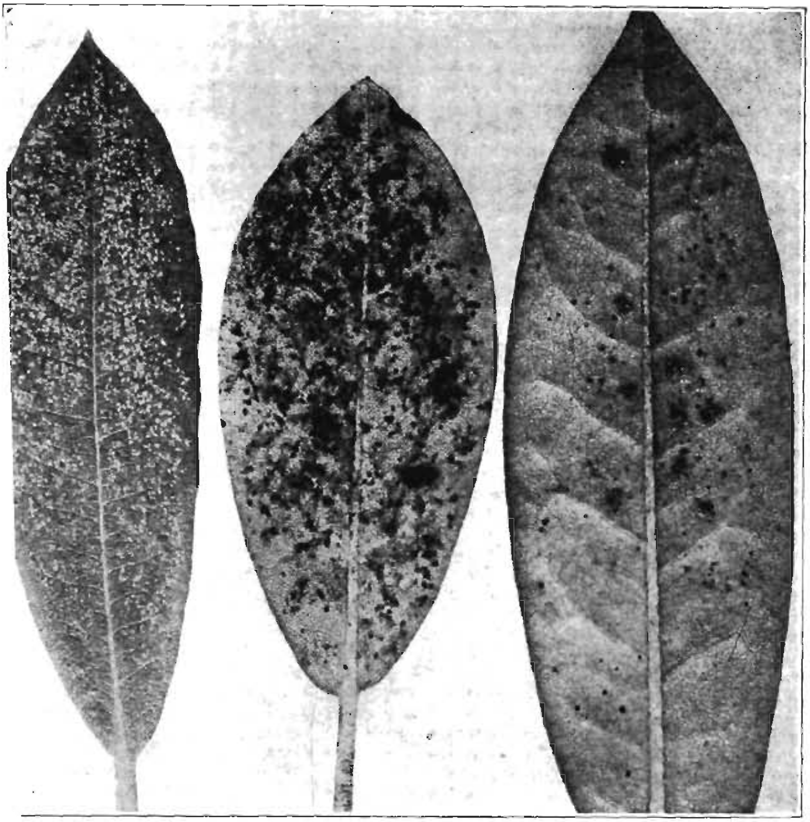


a. Work of columbine leaf miner. Natural size.



b. Adult of stalk borer. Natural size.

c. Immature stalk borer in corn. Natural size.



. Rhododendron leaves injured by rhododendron lace bug, which may be seen on lower surface at right. Leaf at left shows appearance on upper surface.

Bulletin 293 February, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Quality of Vegetable Seed
Bought by
Market Gardeners in Connecticut in 1927

E. M. STODDARD AND A. D. McDONNELL

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

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THE QUALITY OF VEGETABLE SEED BOUGHT BY MARKET GARDENERS IN CONNECTICUT IN 1927

By E. M. Stoddard and A. D. McDonnell

For many years this Station has examined seed for germination and purity. The samples were usually sent in voluntarily by growers and dealers, but this method of obtaining material did not supply sufficient number or distribution of samples to furnish good information on the quality of seed sold in the state. More recently the Sampling Agent has collected vegetable seed from various sources in sufficient quantity to warrant publication of the results as an index to the quality of such seed as sold in Connecticut. In Bulletin 283 (1927) the data on two years' collections of packet seed were given, and at this time we present the data on vegetable seed sold in bulk to market gardeners throughout the State. These samples were obtained from market gardeners and represented seed stocks they had purchased for planting in 1927. The collection was started late and not as many samples could be obtained as we had hoped, but a fairly well distributed lot of 172 samples was collected, which are listed in Table I. This seed is not as good as one might suppose it would be, but compares favorably with similar seed sold in other states, and is for the most part an improvement on the packet seed previously reported in Bulletin 283.

The tests made were for germination only, there being no consideration given to other features relative to the value of the sample.

The standard methods of procedure were followed in making the tests. In brief, 200 seeds were selected from each sample and put in a standard germinating chamber in duplicate lots of 100 seeds each, the smaller seeds being put between blotting paper and the larger seeds, such as corn, peas and beans between paper towels. We find by comparative tests that the paper towels give as good results as cloths and do away with the inconvenience of washing and sterilizing the cloths. The substratum was moistened as necessary with tap water. Each sample was kept in the germinating chamber for the standard number of days required for such seeds, and if the germination of the duplicate samples varied more than 10% a retest was made and the resulting percentages used.

TABLE I. GERMINATION TESTS OF BULK VEGETABLE SEED, 1927.

Test Number	Variety of Seed	Per cent of Germination	Grower
	Beans		
3311	Black Valentine	*84	E. B. Clark Seed Co., Milford, Ct.
3317	Black Valentine	*89	Comstock Ferre Co., Wethersfield, Ct.
3315	Bountiful	98	Frank S. Platt Co., New Haven, Ct.
3316	Cracker Jack	98	Frank S. Platt Co., New Haven, Ct.
3313	Davis White Kidney Wax	97.5	S. D. Woodruff & Sons, Orange, Ct.
3310	Dwarf Wonder of France	95.5	J. Breck Seed Co., Boston, Mass.
3302	Fordhook Bush Lima	*83	S. D. Woodruff & Sons, Orange, Ct.
3305	Golden Cluster Wax	96	Jos. Harris Seed Co., Coldwater, N. Y.
3304	Green Pod Long	97	E. B. Clark Seed Co., Milford, Ct.
3309	Hodson's Wax	99	Frank S. Platt Co., New Haven, Ct.
3303	Round Pod Kidney	96.5	S. D. Woodruff & Sons, Orange, Ct.
3308	Stringless Refugee	*82.5	Jos. Harris Seed Co., Coldwater, N. Y.
3314	Stringless Refugee	98	F. H. Woodruff & Sons, Milford Ct.
3306	White Kid Wax	94	Jos. Harris Seed Co., Coldwater, N. Y.
3307	Yellow Bountiful	98	Frances Stokes & Co., Philadelphia, Pa.
3312	Round Pod Kidney Wax	93	S. D. Woodruff & Sons, Orange, Ct.
	Beets		
3281	Coal Black	89.5	Francis Brill & Co., Hempsted, N. Y.
3278	Crosby's Egyptian	86	Jos. Harris Seed Co., Coldwater, N. Y.
3276	Detroit Dark Red	94	E. B. Clark Seed Co., Milford, Ct.
3282	Detroit Dark Red	88.5	F. H. Woodruff & Sons, Milford, Ct.
3468	Detroit Dark Red	82	F. H. Woodruff & Sons, Milford, Ct.
3286	Detroit Dark Red	*77.5	Frank. S. Platt Co., New Haven, Ct.
3277	Early Wonder	88.5	J. W. Simon & Son, Philadelphia, Pa.
3283	Early Wonder	90	E. B. Clark Seed Co., Milford, Ct.
3284	Early Wonder	*74.5	S. D. Woodruff & Sons, Orange, Ct.
3279	Egyptian	*43.5	David L. Clark & Son, Milford, Ct.
3280	Mangel, Mammoth Long Red	*37.5	Frances Stokes & Co., Philadelphia, Pa.
3275	Woodruff's Early Wonder	*73	F. H. Woodruff & Sons, Milford, Ct.
	Cabbage		
3268	Copenhagen Market	*73	Jos. Harris Seed Co., Coldwater, N. Y.
3270	Copenhagen Market	85	Alex. Forbes & Co., Newark, N. J.
3269	Danish Round Head	*68	C. P. Strandholm, Copenhagen, Denmark
3267	Early Jersey Wakefield	95	Frances Stokes & Co., Philadelphia, Pa.
3272	Early Jersey Wakefield	88.5	Jos. Harris Seed Co., Coldwater, N. Y.
3266	Golden Acre	*84	Frank. S. Platt Co., New Haven, Ct.
3274	Golden Acre	*71	Comstock Ferre Co., Wethersfield, Ct.
3271	Penn. State Bullhead	89	Frances Stokes & Co., Philadelphia, Pa.
3273	Perfection Savoy	86.5	Cadwell & Jones, Hartford, Ct.
	Carrot		
3291	Bagley	89.5	F. H. Woodruff & Sons, Milford, Ct.
3297	Bagley	*56.5	E. B. Clark Seed Co., Milford, Ct.
3292	Chantenay	72	Frank S. Platt Co., New Haven, Ct.

*Below standard.

TABLE I. GERMINATION TESTS OF BULK VEGETABLE SEED, 1927.—*Continued.*

Test Number	Variety of Seed	Per cent of Germination	Grower
	Carrot (*Continued*)		
3299	Chantenay	*35.5	E. B. Clark Seed Co., Milford, Ct.
3300	Chantenay	67	E. B. Clark Seed Co., Milford, Ct.
3301	Chantenay	60	Jos. Harris Seed Co., Coldwater, N. Y.
3295	Danvers	61.5	Frances Stokes Co., Philadelphia, Pa.
3288	Danver's Half Long	63.5	J. W. Simon & Son, Philadelphia, Pa.
3290	Danver's Half Long	*56.5	Cadwell & Jones, Hartford, Ct.
3292	Danver's Half Long	67	C. J. Hart Seed Co., Wethersfield, Ct.
3298	Danver's Half Long	65.5	F. W. Eberle Seed Co., Albany, N. Y.
3294	Hutchingson	89	Jos. Harris Seed Co., Coldwater, N. Y.
3287	Oxheart	*42	Comstock Ferre Co., Wethersfield, Ct.
3296	Pride of Denmark	*59	Jos. Harris Seed Co., Coldwater, N. Y.
3289	Rubicon	60.5	F. W. Eberle Seed Co., Albany, N. Y.
	Celery		
3408	Early Blanching	87.5	E. B. Clark Seed Co., Milford, Ct.
3407	French Success	80	J. W. Simon & Son, Philadelphia, Pa.
3404	Golden Plume or Wonderful	*70	Jos. Harris Seed Co., Coldwater, N. Y.
3406	Golden Self Blanching	*29	Jos. Harris Seed Co., Coldwater, N. Y.
3405	Newark Market	*75.5	Alex. Forbes & Co., Newark, N. J.
3402	Wonderful	*58	F. H. Woodruff & Sons, Milford, Ct.
3403	Woodruff's Wonderful	*64	F. H. Woodruff & Sons, Milford, Ct.
	Corn (Sweet)		
3359	Alfa Sweet	90	Jos. Harris Seed Co., Coldwater, N. Y.
3368	Columbia	95.5	S. D. Woodruff & Sons, Orange, Ct.
3354	Columbia Sweet	91	Comstock Ferre Co., Wethersfield, Ct.
3369	Columbia White	94.5	S. D. Woodruff & Sons, Orange, Ct.
3466	Country Gentleman	*80	Comstock Ferre Co., Wethersfield, Ct.
3358	Cromer's Special Sweet	*88.5	David L. Clark & Son, Milford, Ct.
3365	Early Bantam Sweet	*88.5	Frank S. Platt & Co., New Haven, Ct.
3353	Extra Early Dighton Sweet	97	S. D. Woodruff & Sons, Orange, Ct.
3364	Giant Bantam Sweet	93	Cadwell & Jones, Hartford, Ct.
3362	Golden Bantam	92.5	Comstock Ferre & Co., Wethersfield, Ct.
3363	Golden Bantam Sweet	95.5	Cadwell & Jones, Hartford, Ct.
3370	Golden Early Market	96	Gill Bros. Seed Co., Portland, Ore.
3360	Howling Mob	92	Frank S. Platt Co., New Haven, Ct.
3361	Howling Mob Sweet	94	Cadwell & Jones, Hartford, Ct.
3371	*Long Island Beauty*	*62.5	*David L. Clark & Son, Milford, Ct.*
3357	Malcom Sweet	95	David L. Clark & Son, Milford, Ct.
3465	Stowell's Evergreen	*62	Comstock Ferre & Co., Wethersfield, Ct.
3356	Whipple's	98.5	Frank S. Platt Co., New Haven, Ct.
3355	Whipple's Sweet	99.5	David L. Clark & Son, Milford, Ct.
	Cucumber		
3320	Early Fortune	98	F. C. Stokes Seed Co., Philadelphia, Pa.
3321	Davis Perfect	*60.5	Jos. Harris Seed Co., Coldwater, N. Y.

*Below standard.

TABLE I. GERMINATION TESTS OF BULK VEGETABLE SEED, 1927.—*Continued.*

Test Number	Variety of Seed	Per cent of Germination	Grower
	Cucumber (*Continued*)		
3322	Davis Perfect	*55	Comstock Ferre Co., Wethersfield, Ct.
3323	Davis Perfect	*83	Jos. Harris Seed Co., Coldwater, N. Y.
3319	White Spine	85.5	W. F. Cobb & Co., Franklin, Mass.
	Egg Plant		
3324	Black Beauty	88.5	Jos. Harris Seed Co., Coldwater, N.Y.
	Lettuce		
3446	Big Boston	99.5	Frank S. Platt Co., New Haven, Ct.
3445	Black Seeded Tennis Ball	*39.5	Frank S. Platt Co., New Haven, Ct.
3435	Black Seeded Tennis Ball	*88.5	F. H. Woodruff & Sons, Milford, Ct.
3448	Early May King	98	F. H. Woodruff & Sons, Milford, Ct.
3442	Eberle Supreme	93.5	F. W. Eberle Seed Co., Albany, N. Y.
3450	Market Gardeners' Private Stock	*82.5	J. W. Simon & Son, Philadelphia, Pa.
3434	May King	*89.5	F. W. Eberle Seed Co., Albany, N. Y.
3467	May King	*82	Jos. Harris Seed Co., Coldwater, N. Y.
3441	May King	*81	F. W. Eberle Seed Co., Albany, N. Y.
3428	New York	92.5	Olds & Whipple, Hartford, Ct.
3429	New York	96	Comstock Ferre & Co., Wethersfield, Ct.
3430	New York	93.5	F. W. Eberle Seed Co., Albany, N. Y.
3431	New York	96.5	Comstock Ferre & Co., Wethersfield, Ct.
3432	N. Y. or Iceberg	93.5	F. W. Eberle Seed Co., Albany, N. Y.
3439	Salamander	98	F. W. Eberle Seed Co., Albany, N. Y.
3443	Salamander	97	Alex. Forbes Seed Co., Newark, N. J.
3444	Salamander	98	Comstock Ferre & Co., Wethersfield, Ct.
3449	Simon's Cabbage Head	97	J. W. Simon & Son, Philadelphia, Pa.
3438	Special Stock	92	F. H. Woodruff & Sons, Milford, Ct.
3433	Supreme	90	F. W. Eberle Seed Co., Albany, N. Y.
3440	Unrivalled	98.5	F. W. Eberle Seed Co., Albany, N. Y.
3447	Unrivalled	98	Comstock Ferre & Co., Wethersfield, Ct.
3436	Wonderful	90	Jos. Harris Seed Co., Coldwater, N. Y.
	Muskmelon		
3419	Abbot's Pearl Pink Meat	*57.5	Ebbert Seed Co., Rocky Ford, Colo.
3417	Bender's Surprise	97.5	Cadwell & Jones, Hartford, Ct.
3424	Bender's Surprise	94	Frances C. Stokes & Co., Philadelphia, Pa.
3427	Bussee Gem	*69	W. Atlee Burpee Co., Philadelphia, Pa.
3459	Cal. Cream	*70	Henry Field Seed Co., Shenandoah, Ia.
3425	Hearts of Gold	*80.5	Frances C. Stokes & Co., Philadelphia, Pa.
3420	Knight	97	Frances C. Stokes & Co., Philadelphia, Pa.
3426	Lake Champion	*83.5	J. W. Simon & Son, Philadelphia, Pa.
3458	Osage	*48.5	S. D. Woodruff & Sons, Orange, Ct.
3418	Ticonderoga	*70	Unknown
3423	Yorko	94.5	J. Breck Seed Co., Boston, Mass.

*Below standard.

TABLE I. GERMINATION TESTS OF BULK VEGETABLE SEED, 1927.—*Continued.*

Variety of Seed	Per cent of Germination	Grower
Onion		
Danvers	92	Frances Stokes Seed Co., Philadelphia, Pa
Parsnip		
Harris Model	*55	Jos. Harris Seed Co., Coldwater, N. Y.
Harris Model	67	Jos. Harris Seed Co., Coldwater, N. Y.
Hollow Crown	*47	Frank S. Platt Co., New Haven, Ct.
Woodruff's Rival	65	S. D. Woodruff & Sons, Orange, Ct.
Pea		
World's Record	*80.5	Frank S. Platt Co., New Haven, Ct.
Pepper		
Bull Nose	*64.5	Frank S. Platt Co., New Haven, Ct.
Golden Dawn	83	Jos. Harris Seed Co., Coldwater, N. Y.
Simon's World Beater	71.5	J. W. Simon & Son, Philadelphia, Pa.
Simon's Jersey Giant	78	J. W. Simon & Son, Philadelphia, Pa.
World Beater	90	F. H. Woodruff & Sons, Milford, Ct.
Radish		
Early Scarlet	93.5	E. B. Clark Seed Co., Milford, Ct.
Early Scarlet Globe	93.5	Frank S. Platt Co., New Haven, Ct.
Giant Crimson	85.5	Frances Stokes Co., Philadelphia, Pa.
Scarlet Globe	*56	S. D. Woodruff & Sons, Orange, Ct.
Scarlet Globe	*74	F. H. Woodruff & Sons, Milford, Ct.
Salsify		
Mammoth Sandwich Island	48.5	Cadwell & Jones, Hartford, Ct.
Spinach		
Bloomsdale Savoy	*50.5	E. B. Clark Seed Co., Milford, Ct.
Giant Thick Leaf	86.5	E. B. Clark Seed Co., Milford, Ct.
Hot Weather	*51	F. H. Woodruff & Sons, Milford, Ct.
Juliana	*37	J. W. Simon & Co., Philadelphia, Pa.
King of Denmark	69	Comstock Ferre Co., Wethersfield, Ct.
King of Denmark	*46.5	E. B. Clark Seed Co., Milford, Ct.
Large Viroflay	*37	Comstock Ferre Co., Wethersfield, Ct.
Long Season	*49	F. W. Eberle Seed Co., Albany, N. Y.
Long Standing	*55.5	W. F. Cobb & Co., Franklin, Mass.
Princess Juliana	*60	Peter Henderson & Co., New York, N. Y.
Princess Juliana	*57	Comstock Ferre Co., Wethersfield, Ct.
Round Thick Leaf	*64.5	F. H. Woodruff & Sons, Milford, Ct.
Viroflay	*58.5	S. D. Woodruff & Sons, Orange, Ct.
Woodruff's Hot Weather	*56.5	F. H. Woodruff & Sons, Milford, Ct.
Squash		
Black Michigan	*88	Unknown
Giant Summer Crookneck	*89.5	F. H. Woodruff & Sons, Milford, Ct.

*Below standard.

TABLE I. GERMINATION TESTS OF BULK VEGETABLE SEED, 1927.—*Concluded.*

Test Number	Variety of Seed	Per cent of Germination	Grower
	Tomato		
3375	Bonny Best	91.5	Vaughan's Seed Store, New York, N.
3383	Canadian	92.5	Jos. Harris Seed Co., Coldwater, N. Y
3378	Earliana	*81	Comstock Ferre Co., Wethersfield, Ct
3379	Earliana	94.5	Jos. Harris Seed Co., Coldwater, N. Y
3380	Earliana	96.5	Jos. Harris Seed Co., Coldwater, N. Y
3381	Earliana	92.5	Vaughan's Seed Store, New York, N.
3384	Earliana	94.5	Jos. Harris Seed Co., Coldwater, N. Y
3382	Early Prolific	94.5	F. W. Eberle Seed Co., Albany, N. Y.
3387	Greater Baltimore	86.5	Comstock Ferre Co., Wethersfield, Ct
3388	Greater Baltimore	93.5	F. H. Woodruff & Sons, Milford, Ct.
3376	John Baer	91.5	Vaughan's Seed Store, New York, N.
3377	John Baer	89	Jos. Harris Seed Co., Coldwater, N. Y
3389	Marglobe	96	Frances C. Stokes & Co., Philadelphia,
3386	Marvana	*62.5	Jos. Harris Seed Co., Coldwater, N. Y
3373	Matchless	*80.5	Thos. Griswold & Co., So. Wethersfiel
3374	Matchless	87	Vaughan's Seed Store, New York, N.
3385	New Dwarf Stone	96.5	Jos. Harris Seed Co., Coldwater, N. Y
3390	Stone	87	Cadwell & Jones, Hartford, Ct.
	Turnip		
3344	Early White Milan	*78	Comstock Ferre Co., Wethersfield, Ct.
3345	Yellow Globe	*65	Comstock Ferre Co., Wethersfield, Ct
	Watermelon		
3409	Kleckly Sweet	*39	Frances C. Stokes & Co., Philadelphia

*Below standard.

GERMINATION STANDARDS FOR VEGETABLE SEED.

In the absence of official standards of germination for vegetable seeds we have adopted a table of standards (Table II). These standards were obtained by plotting a frequency curve of all the germination tests made of the several seeds in our laboratory and the published data of four other seed laboratories for the last twenty-three years (1905-1927 inclusive) and taking the classes included in the peak of the curve as a standard. No standard was adopted without data from at least 50 samples.

After collecting much additional data we found it necessary to change slightly a few of the standards adopted in Bulletin 283 published by this Station in January, 1927.

In view of the fact that the data used covered a long period of time and was taken from various parts of the country, we feel that the standards adopted are a fair measure of germination for good seed of the various kinds. The following graph of onion seed illustrates the method used:

GRAPH OF GERMINATION TESTS OF 2245 SAMPLES OF ONION SEED

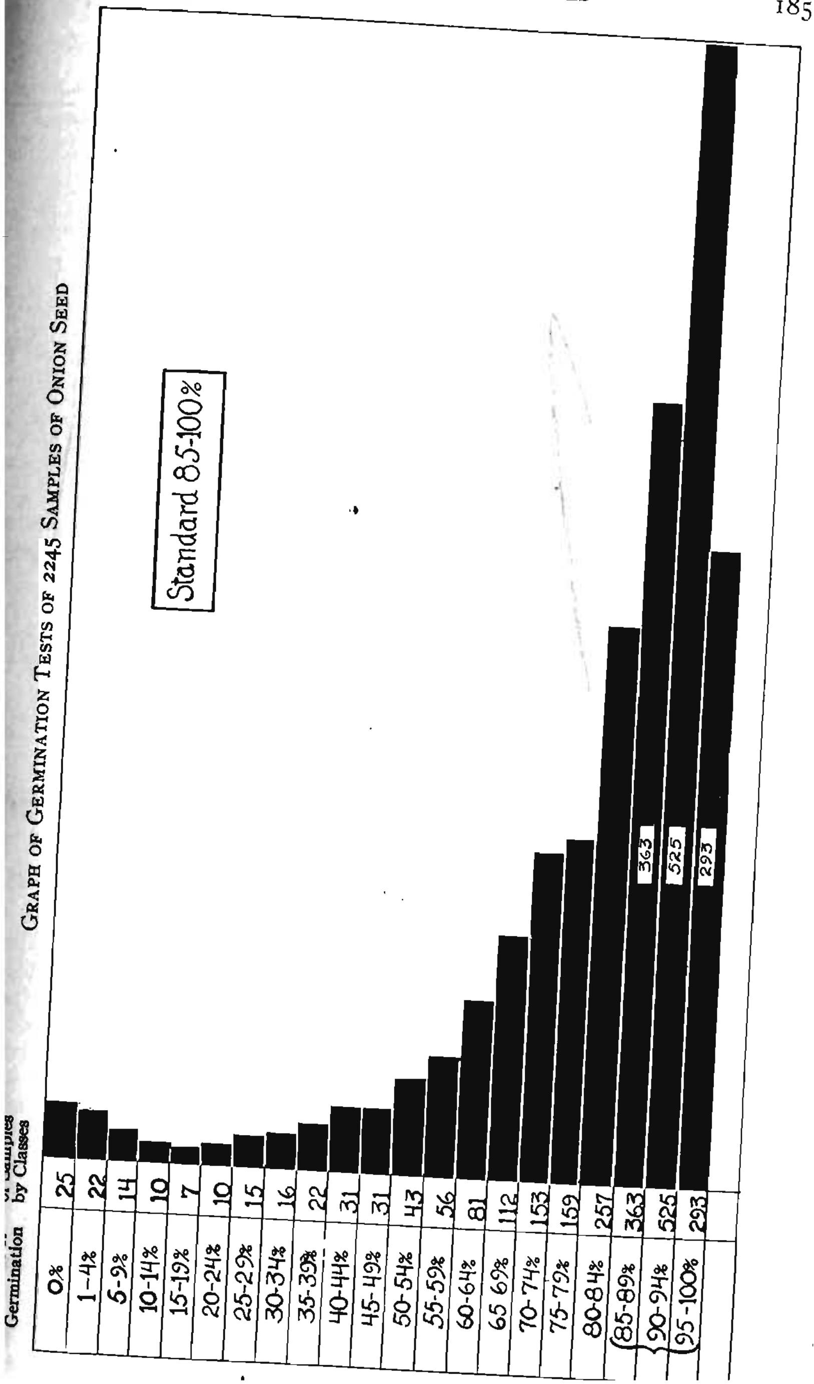

TABLE II. TABLE OF GERMINATION STANDARDS ADOPTED.

Seed	Germination Standard	Number of Tests Used to Compute Standard
Beans	90 to 100%	439
*Beet	80 " 95%	331
Cabbage	85 " 100%	350
Carrot	60 " 75%	236
Celery	80 " 90%	163
Corn (Sweet)	90 " 100%	559
Cucumber	85 " 100%	224
Lettuce	90 " 100%	439
Muskmelon	85 " 100%	194
Onion	85 " 100%	2245
Parsnip	60 " 75%	154
Peas	90 " 100%	519
Pepper	60 " 75%	116
Radish	85 " 100%	478
Spinach	65 " 80%	311
Squash	85 " 100%	89
Tomato	85 " 100%	288
Turnip	90 " 100%	177
Watermelon	80 " 95%	59

* The germination of beet seed was determined by counts of the number of seed balls germinating and not number of sprouts.

THE QUALITY OF THE SEED TESTED IN 1927.

Applying the standards as shown in Table II to the seed collected and tested in 1927 the following results are obtained:

TABLE III. THE QUALITY OF THE SEED TESTED IN 1927.

Seed	Number of Samples	Per cent of Samples Equaling or Exceeding the Standard
Beans	16	75.0
Beet	12	59.4
Cabbage	9	65.6
Carrot	15	66.6
Celery	7	28.6
Corn (Sweet)	19	73.7
Cucumber	5	40.0
Egg Plant	1	*
Lettuce	23	73.9
Muskmelon	11	36.4
Onion	1	100.0
Parsnip	4	50.0
Peas	1	0
Pepper	5	100.0
Radish	5	60.0
Salsify	1	*
Spinach	14	14.3
Squash	2	0
Tomato	18	83.4
Turnip	2	0
Watermelon	1	0

* No standard adopted.

BULLETIN 294 FEBRUARY, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

TWENTY-SEVENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

1927

W. E. BRITTON, Ph.D.
State Entomologist

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

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CONTENTS

	PAGE
Twenty-seventh Report of the State Entomologist of Connecticut	193
Letter of Submittal	193
Summary of Inspection and Office Work	193
Publications of the Entomological Department	194
Report of Receipts and Expenditures	195
Department Staff and Work	196
Entomological Features of 1927	198
Fruit Insects	198
Vegetable Insects	201
Shade and Forest Tree Insects	204
Insects Attacking Ornamental Shrubs and Plants	207
Miscellaneous Insects	209
Convention of Entomological Workers	209
Inspection of Nurseries in 1927	210
Nursery Firms Receiving Certificates in 1927	215
Inspection of Imported Nursery Stock	221
Inspection of Apiaries in 1927	223
Gipsy Moth Work in Connecticut, 1927	231
Operations for the Control of the European Corn Borer	246
Quarantine	252
Further Reports on the Spraying and Dusting of Apples	256
Cankerworms in New London County	261
The Oriental Peach Moth in Connecticut	263
Weather Conditions Accompanying the Aphid Outbreak in Connecticut in 1927	271
Tests with Insecticides Designed to do the Work of Nicotine Sulphate	277
The Carrot Rust Fly	278
The European Hen Flea in Connecticut	279
Report of the Activities to Control the Japanese Beetle in 1927	281
Report of Asiatic Beetle Control and Quarantine Work in 1927	288
Mosquito Control Work in Connecticut	291
Miscellaneous Insect Notes	296
Severe Injury to Fruit by the Green Apple Aphid	296
Brown Scale on Arborvitae	296
Abundance of the Mealy Plum Aphid	297
Watch for 17-year Locust in 1928	297
Abundance of the Raspberry Sawfly	297
The Poplar and Willow Curculio	297
The Blackberry Psyllid	298
A New Mosquito Ditching Spade	298
The Greenhouse or Celery Leaf-Tyer	298
Cottony Maple-Leaf Scale on Dogwood	298
Index	301

AUTHORSHIP

For bibliographical purposes all material published in this Report (Bulletin 294), unless otherwise indicated, should be credited to W E. Britton.

ILLUSTRATIONS

The illustrations in this Report (Bulletin 294) are from the following sources: Figs. 38, 39, and 48, outline maps shaded by B. H. Walden; Figs. 40 to 47 are maps, charts, and one (Fig. 43) illustrating insects drawn by Dr. Philip Garman. Plates are all from photographs: XXI, XXII a, XXIII, and XXIV, by W. E. Britton; XXII b, by N. E. Guertin; XXV by M. P. Zappe; XXVII c, by P. Garman; XXXIII to XXXVI by R. C. Botsford; all others by B. H. Walden.

BULLETIN 294

TWENTY-SEVENTH REPORT

OF THE

State Entomologist of Connecticut

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I have the honor to transmit herewith my twenty-seventh annual report as State Entomologist of Connecticut. This report contains an account of each of the activities of the Department of Entomology of the Station, including the inspection and control operations prescribed by Statute, and the various lines of research in which the members of the Department staff have been engaged during the year of 1927.

Respectfully submitted,
W. E. BRITTON,
State and Station Entomologist.

SUMMARY OF INSPECTION AND OFFICE WORK

305 samples of insects received for identification.
208 nurseries inspected.
206 regular certificates granted.
206 duplicate certificates furnished to be filed in other states.
2 special raspberry certificates granted.
80 nursery dealers' permits issued.
213 shippers' permits issued to nurserymen in other states.
190 parcels of nursery stock inspected and certified.
230 bales of mountain laurel and other decorative material inspected and certified for shipment.
20,000 narcissus bulbs inspected and certified.
259 shipments of seed corn inspected and certified.
34 orchards and gardens examined.
31 shipments, containing 321 cases, 3,229,915 plants, imported nursery stock inspected.
22 shipments, or 70 per cent, found infested with insects or plant diseases.
803 apiaries, containing 8,133 colonies, inspected.
9 apiaries and 23 colonies found infested with European foul brood.
25 apiaries and 57 colonies found infested with American foul brood.
3,336 letters written on official work.
789 circular letters sent out.
385 post cards.
51 reports to Federal Horticultural Board.
2,146 bulletins, etc., mailed on request or to answer inquiries.
86 packages sent by mail or express.
62 lectures and addresses at meetings.

PUBLICATIONS OF THE ENTOMOLOGICAL DEPARTMENT, 1927

BY W. E. BRITTON:

Twenty-sixth Report of the State Entomologist of Connecticut (Bulletin 285), 124 pages, 11 figures, 16 plates; 9,600 copies distributed in April, 1927.

The Asiatic Beetle Quarantine, Bulletin of Immediate Information No. 55, 4 pages, 2 figures, November 10, 1926; 2,000 copies.

The Japanese Beetle Quarantine, Bulletin of Immediate Information No. 56, 4 pages, 1 figure, November 10, 1926; 2,000 copies.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada, Bulletin of Immediate Information No. 57, 32 pages, November 20, 1926; 1,775 copies.

The Japanese Beetle Quarantine, Bulletin of Immediate Information No. 58, 8 pages, May 16, 1927; 2,500 copies.

The European Corn Borer Quarantine, Bulletin of Immediate Information No. 59, 5 pages, 1 figure, June 1, 1927; 1,500 copies.

Twelfth Biennial Report of the Commissioners of the State Geological and Natural History Survey, Bulletin No. 38, 23 pages, 1 plate, April, 1927.

Mosquito Expugnatus Est, Homo Victor. Engineering News-Record, Vol. 97, page 922, Dec. 3, 1926.

Book Review: Blatchley's Heteroptera of Eastern North America. Entomological News, Vol. xxxviii, page 90, March, 1927.

Organization of a Co-operative Campaign Against the Asiatic Beetle. Journal Economic Entomology, Vol. 20, page 359, April, 1927.

The Japanese Beetle in Connecticut. Proceedings 36th Annual Meeting Connecticut Pomological Society, page 45, April, 1927.

Report of Committee on Injurious Insects. Proceedings 36th Annual Meeting Connecticut Pomological Society, page 40, April, 1927.

BY W. E. BRITTON AND M. P. ZAPPE:

Inspection of Nurseries in 1926, 13 pages (reprinted from the Report), 300 copies, April, 1927.

BY W. E. BRITTON AND P. J. ANDERSON:

Tobacco Insects in 1926, Tobacco Station Bulletin, 8, page 52T, 3 pages, April, 1927.

BY PHILIP GARMAN:

The Problem of Curculio Control in Connecticut Apple Orchards. Journal Economic Entomology, Vol. 20, page 196, February, 1927.

The Oriental Peach Moth in Connecticut and Results of Control Work in 1926. Proceedings 36th Annual Meeting Connecticut Pomological Society, page 46, April, 1927.

Feeding Habits Among Insects and Their Relation to Control Measures. American Produce Grower, Vol. II, No. 4, pages 3 and 26, April, 1927.

The Odonata or Dragonflies of Connecticut, Bulletin No. 39, State Geological and Natural History Survey, 331 pages, 67 figures, 22 plates; 3,000 copies, July, 1927.

BY R. B. FRIEND:

The Birch Leaf Skeletonizer, *Bucculatrix canadensisella* Chambers (Bulletin 288), 94 pages, 29 figures, 2 plates; 2,500 copies, June, 1927.

The Spruce Gall Aphid (*Adelges abietis* Linn.) and Its Control. 6 pages, 4 plates (reprinted from the Report); 1,000 copies, April, 1927.
The Asiatic Beetle. *Anomala orientalis* Waterh. Journal Economic Entomology, Vol. 20, page 362, April, 1927.

By J. Peter Johnson:

Soil Treatment and Scouting for the Control of the Asiatic Beetle. Journal Economic Entomology, Vol. 20, page 373, April, 1927.

By M. P. Zappe:

Spraying Practices. Proceedings 36th Annual Meeting Connecticut Pomological Society, page 23, April, 1927.

By R. C. Botsford:

Results Obtained in Anti-Mosquito Work in Connecticut in 1926. Proceedings 14th Annual Meeting of the New Jersey Mosquito Extermination Association, page 115, 4 pages, June, 1927.

INSECT PEST ACCOUNT

Report of Receipts and Expenditures of the State Entomologist

From July 1, 1926 to June 30, 1927

Receipts

Insect Pest Appropriation, biennial period ending June 30, 1927	$35,000.00	
Additions, miscellaneous receipts*	50.68	
Deficiency appropriation, Board of Control and General Assembly of 1927	13,500.00	
	$48,550.68	
Expended to July 1, 1926	22,108.11	
Balance available, July 1, 1926		$26,442.57

Disbursements

Salaries	$15,570.31
Labor	2,967.96
Stationery and office supplies	101.62
Scientific supplies (chemicals)	34.79
" " (other laboratory supplies)	32.21
" " (photographic)	43.58
Feeding stuffs	.55
Insecticides, etc.	2,586.60
Lumber and small hardware	9.48
Fuel oil	459.53
Miscellaneous supplies	175.86
Automobile oil	38.38
Telephone and telegraph	69.36
Postage	96.95

Travel (outlying investigations)	715.72	
" (meetings, conferences, etc.)	259.95	
" (gasoline for automobiles)	427.25	
Freight, express and parcel post	149.00	
Publications (zinc cut)	2.50	
Coal	5.10	
Electricity	4.00	
Water	34.60	
Furniture and fixtures (new)	112.85	
" " " (repairs)	3.47	
Library (books and periodicals)	45.21	
Scientific equipment (new)	143.06	
" " (repairs)	3.50	
Tools, machinery and appliances (new)	960.98	
" " " " (repairs)	41.65	
Automobiles (repairs)	475.86	
New buildings and structures	9.91	
Buildings (repairs and alterations)	16.04	
Rent of land and building	416.63	
Insurance (automobile)	225.41	
Miscellaneous contingent expenses	202.70	
Total disbursements		$26,442.57

* Use of automobiles at 6 cents per mile	$42.48
Sale of honey	8.20
	$50.68

DEPARTMENT STAFF AND WORK

W. E. Britton, Ph. D., *State and Station Entomologist.*

B. H. Walden, B.Agr., *Photographic and General Work*
M. P. Zappe, B.S., *Inspection and General Work*
Philip Garman, Ph.D., *Research Work*
Roger B. Friend, Ph.D., *Research Work*
} *Assistant Entomologists.*

J. Peter Johnson, B.S., *Deputy in Charge of Asiatic and Japanese Beetle Quarantines.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
James A. McEvoy, *Assistant in Gipsy Moth Work.*
Robert C. Botsford, *Deputy in Charge of Mosquito Work.*
Miss Grace A. Foote, B.A., *Secretary.*
H. W. Coley, Westport
A. W. Yates, Hartford
} *Apiary Inspectors.*

Mr. Walden has continued to serve as chief photographer, has had charge of exhibits for the department, has been in charge of the office during the absence of the Entomologist, and has assisted in scoring fruit and in the general work of the department. He has also continued his researches on the imported currant worm, *Pteronidea ribesi* Scop.

Mr. Zappe has continued in charge of the inspection of nursery stock, and of the clean-up work around infestations of the European corn borer, in co-operation with the Federal Bureau of Ento-

mology. He has collaborated with Dr. Garman in the study of the plum curculio in apple orchards, and with Mr. E. M. Stoddard of the Botany Department, in dusting and spraying experiments in apple orchards.

Dr. Garman has continued his studies on the life history and control of the Oriental peach moth, *Laspeyresia molesta* Busck. In co-operation with Mr. Zappe, he has also continued the investigations of the plum curculio, *Conotrachelus nenuphar* Hbst., in apple orchards begun in 1923. Dr. Garman has kept in touch with the European red mite situation and with the chemistry of insecticides. He has also given much of his time to revising the manuscript and reading the proof of his paper on *The Odonata or Dragonflies of Connecticut,* which has been published during the year as Bulletin No. 39 of the State Geological and Natural History Survey.

Dr. Friend has completed graduate work in Yale University and received the degree of doctor of philosophy in June. His thesis was "The Biology of the Birch Leaf Skeletonizer, *Bucculatrix canadensisella* Chambers," and was published during the summer as Bulletin 288 of this Station. Dr. Friend has also been in charge of the investigations on the life history and habits of the Asiatic beetle, *Anomala orientalis* Waterhouse, which are now nearly complete, and the results are being co-ordinated and tabulated for publication. He has also given some time to a study of the methods of control of certain insect pests of vegetable crops, and to the life history of the birch leaf miner, *Fenusa pumila* Klug.

Mr. John T. Ashworth has continued to serve as deputy in charge of gipsy moth work with headquarters at Danielson. He has been assisted by Mr. James A. McEvoy, and, as in former years, the work has been conducted with vigor and efficiency in cooperation with the Federal Bureau of Entomology.

Mr. Robert C. Botsford has continued to serve as deputy in charge of mosquito elimination work and has supervised important new ditching projects in Westport and Westbrook besides maintaining the ditches in the other areas accepted for State maintenance.

Mr. J. Peter Johnson has been in charge of the quarantine and soil treatment work against the Asiatic beetle, and of the Federal and State quarantines against the Japanese beetle. Mr. Johnson is an agent of the Federal Bureau of Entomology, and from June 15 to December 31, maintained an office in Stamford, with a force of men sufficient to make the necessary inspections, issue certificates, and patrol all the principal highways leading northward and eastward out of the quarantined area.

Mr. B. W. McFarland has been employed throughout the season to assist in the Asiatic beetle work, and Mr. Charles R. Biecher assisted in the insectary from June 1 until September 1.

Mr. J. Leslie Rogers was employed from June 12 to September 20, when he returned to college. He and Messrs. J. F. Townsend, A. P. Harger, and H B. Bender assisted Mr. Zappe in nursery inspection between July 1 and October 1. Mr. Townsend worked scouting for the Asiatic beetle and also on the corn borer clean-up operations.

Messrs. A. W. Yates, Hartford, and H. W. Coley, Westport, have served as apiary inspectors as in former seasons, on a *per diem* basis.

Miss Grace A. Foote has served as secretary throughout the year. During the vacation period, Miss Helen N. Fox was employed to do the necessary work of the office.

The Entomologist here desires to express his appreciation of the earnest, faithful, and efficient efforts of all members of the department staff. Without such service the work could not have been done.

The Entomologist has continued to direct the work of the department and has given his personal attention to the office correspondence. During the year he has been made responsible for the conduct of the mosquito elimination work, with Mr. Botsford in immediate charge. He has also continued to serve as Associate Editor of the *Journal of Economic Entomology,* and as Insect Pest Reporter in Connecticut for the Insect Pest Survey of the Bureau of Entomology. He is also Chairman of the Tree Protection Examining Board, and Superintendent of the Geological and Natural History Survey of Connecticut and has devoted some of his time to these matters.

The chief activities of the department are described in some detail in the following pages of this Report.

ENTOMOLOGICAL FEATURES OF 1927

The season of 1927 was a peculiar one in many respects. Spring and early summer were cool, with rather light rainfall. A few hot days came in July, and the precipitation was abundant in July, August, and September. In general, aphids were unusually abundant on all kinds of trees and plants—more abundant than in any season within the memory of the Entomologist.

Fruit Insects

Though not particularly prevalent in orchards in May and June, the green apple aphid, *Aphis pomi* De G., later became so very abundant that it attacked and injured the fruit. Specimens of this aphid were received from Woodmont, Windsor, and Litchfield, and it was found in 36 nurseries at the time of the annual inspection. The rosy apple aphid, *Anuraphis roseus* Baker, was rather

scarce in the orchards visited until about July 1, when it was found to have increased rapidly. This insect was sent to the Station from Westport and West Haven. The observations made in Connecticut orchards by Messrs. Zappe, Stoddard, and Dr. Garman, indicate that lady beetles and Syrphid flies were present in nearly all cases and were expected to control the aphids, but for some unknown reason failed to hold them in check.

The woolly apple aphid, *Eriosoma lanigerum* Hausm., was present as usual in orchards and nurseries, and was sent to the Station from Hamden, June 15, from New Haven, June 16 and 20, and was observed in 43 nurseries.

Work of the currant aphid, *Myzus ribis* Linn., was received from West Cornwall, June 22, from Litchfield, July 7, and was observed in five nurseries. The cherry aphid, *Myzus cerasi* Fabr., was sent in from Wallingford, July 12, and was likewise observed in five nurseries. The mealy plum aphid, *Hyalopterus arundinis* Fabr., was prevalent on European plum but did not infest the Japanese plum.

Leafhoppers were extremely abundant on apple during the season and undoubtedly caused considerable injury both in orchards and nurseries. Though several species are probably involved, generally the most abundant kind in the orchard is the rose leafhopper, *Empoa rosae* Linn., and the predominant one in nurseries is the apple leafhopper, *Empoasca mali* Le B. Though not specifically identified in all cases, leafhoppers seemed to be more abundant than usual and caused the mottling of leaves in many apple orchards. They were also present on apple stock in 60 nurseries.

The pear psylla, *Psylla pyricola* Först, was also abundant on pear trees. It was received from New Haven, North Haven and Litchfield, and observed in 24 nurseries. The first adult was observed by Mr. Stoddard on March 16. A dormant spray of lime-sulphur (1-9) with nicotine in spring is probably the best treatment to kill the eggs. Summer sprays of nicotine and soap may be necessary to hold the insect in check and to clean up the fruit.

The San José scale, *Aspidiotus perniciosus* Comst., was not particularly prominent during the season. It was received only once at the Station (from Danbury) and was found in 16 nurseries.

The European red mite, *Paratetranychus pilosus* C. & F., seems to be on the increase in Tolland County and probably throughout the State. Specimens were received from Nichols and Glastonbury, and the pest was observed in many orchards and in 11 nurseries. Spraying the dormant trees with a miscible oil is the best treatment to kill the eggs.

The pear leaf blister mite, *Eriophyes pyri* Pagnst., was rather prevalent, having been received at the Station twice from New Haven, and found in 39 nurseries.

The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, was seemingly more abundant than in 1925 and 1926. During the last two months the adults have been rather common, resting on window screens around New Haven. This insect was found in 22 nurseries. It is easily controlled by spraying with lead arsenate.

The fall cankerworm, *Alsophila pometaria* Harris, which is always locally abundant, was present in moderate numbers in New Haven and Hamden, and was received from Westport, Colchester, and East Lyme. A fairly large area at "Point O' Woods" in East Lyme was almost completely defoliated, including fruit trees and the native growth in woodland and along the roadside. The caterpillars died in large numbers from a wilt disease, and a large native ground beetle, *Calosoma scrutator* Fabr., fed upon the cankerworms.

The Eastern tent caterpillar, *Malacosoma americana* Fabr., was very abundant over the greater portion of the State. Specimens were received from West Haven, Waterbury, and Middletown. Many caterpillars when nearly full grown carried the eggs of Tachinid parasites, and thousands died from a wilt disease. It is almost certain that this insect will continue to decrease during the next few years.

The fall webworm, *Hyphantria cunea* Drury, was present in usual abundance throughout the State, and the nests could be seen on all kinds of fruit, shade and woodland trees, in late summer.

The codling moth, *Carpocapsa pomonella* Linn., was present throughout the State as usual, and was sent in from Danbury. The plum curculio, *Conotrachelus nenuphar* Hbst., was perhaps rather more troublesome than usual, and specimens were received showing injury to peach from South Britain, and to apple from Danbury and West Haven. Both these insects are best controlled by frequent applications of lead arsenate. Other leaf feeders on apple received from correspondents are: the white-marked tussock moth, *Hemerocampa leucostigma* S. & A., from Shelton, and on raspberry from Bristol; the red-banded leaf roller, *Eulia velutinana* Walker, from Plantsville; the apple bucculatrix, *Bucculatrix pomofoliella* Clem., from Shelton; the yellow-necked caterpillar, *Datana ministra* Drury, from Plantsville and Old Lyme; the red-humped caterpillar, *Schizura concinna* S. & A., from Hamden; the green fruit worm, *Xylina antennata* Walker, from New Haven; the bud moth, *Tmetocera ocellana* Schiff., from Danbury, and the snow-white linden moth, *Ennomos subsignarius* Hubn., from Glastonbury.

The Oriental peach moth, *Laspeyresia molesta* Busck, is now distributed throughout the State, and there seems to have been a general increase in Fairfield, New Haven, and Hartford Counties. Larvae in quince were received from Middletown in October. There seems to be no satisfactory control for this insect.

The pear midge, *Contarinia pyrivora* Riley, has been prevalent in certain localities. We have observed it in New Haven, and specimens were received from Norwalk and Rockville in June. The pear slug or sawfly, *Eriocampoides limacina* Retz., has been very abundant on pear and cherry in orchards, and was found in 24 nurseries.

The apple maggot, *Rhagoletis pomonella* Walsh, has been rather more abundant than usual, especially in New Haven and Tolland Counties, and was not wholly controlled by careful spraying.

The European fruit scale, *Lecanium corni* Bouché, was received from Wethersfield in June on Japanese plum. The raspberry sawfly, *Monophadnoides rubi* Harris, was very abundant locally, and small plantations in Hamden and West Haven were entirely defoliated in June.

There has been no prominent increase in the spread of the gipsy moth, *Porthetria dispar* Linn., though a small infestation was discovered in Woodbridge and another in Oxford. The towns of Goshen and Litchfield have been removed from Federal and State quarantine. No noticeable defoliation has occurred in Connecticut, though more than 130,000 acres of woodland in Massachusetts, and about 5,000 acres each in New Hampshire and Maine were stripped by the caterpillars in 1927.

The Japanese beetle, *Popillia japonica* Newm., which was discovered in Connecticut at Stamford, in September, 1926, has now reached Bridgeport, where several hundred beetles, well distributed over the city, were found by Federal scouts.

Vegetable Insects

I am indebted to Prof. A. E. Wilkinson for much of the data regarding vegetable insects used in the following pages:

Cutworms were more than usually troublesome all through the State on a variety of crops, causing damage estimated to be from 5 to 25 per cent in various localities. There are several different species of cutworms, all being the larvae of noctuid moths and varying somewhat in their habits. We have not had material for identification so cannot be certain of the species responsible for the injury. In one instance, however, in a greenhouse in Danbury, April 7, carnations had from two to five cutworms per plant, and we are safe in ascribing this damage to the variegated cutworm, *Lycophotia margaritosa saucia* Hbn., which has the habit of climbing, and eating holes in the buds, often causing much damage to plants under glass. Other kinds of cutworms are present in the open field, and we have records of injury as follows: to peas, Thomaston, May 6; to cabbage and early cauliflower, Stratford, May 3, Thomaston, May 6; Lebanon, Black Hall, Groton, and South Windsor, May 11; Southington and Farmington, May 13;

Hampton, Danielson, Brooklyn, Canterbury, Wauregan, Pomfret Center, May 17; Putnam, Woodstock, East Woodstock, May 18; to asparagus, Norwich, May 12, and Southington, May 13; to peppers, Plainville, May 13; to beets and tomatoes, Woodstock and Putnam, May 18. At a meeting at Hartford on May 12, twelve men asked for cutworm remedies; they were from Burnside, Wapping, East Hartford, West Avon, Rocky Hill, Wethersfield, and Windsor. Cutworms were present in all house gardens at Storrs, June 2. On May 20, specimens were received from Mystic of the larvae of *Feltia venerabilis* Walker, another of the climbing cutworms which does not cut off the stem. These larvae were feeding upon various vegetable plants. In such a case, spraying with lead arsenate is the remedy. For those kinds that cut off the stems, it is best to distribute some poisoned bait around the field several days before the plants are set, or before the seedlings reach the size to be injured. A formula for this bait is as follows:

Wheat bran	5 lbs.
White arsenic or Paris green	4 oz.
Cheap molasses	1 pint
Orange or lemon	1 fruit
Water	7 pints

Cut the fruit into small pieces and mix all together to form a rather dry mash, and scatter around the field. Mr. Peckham wrote that cutworms bothered him so little that he never reset a plot of any transplanted crop on account of them.

The Colorado potato beetle, *Leptinotarsa decemlineata* Say, seems to have been very abundant in some localities and very scarce in others. Severe injury was reported in four fields at Westport, July 6, two fields at Brookfield, and one field at East Danbury, July 7. Certain fields in Hamden were quite free from attack. Of course spraying or dusting with lead arsenate is the remedy.

The striped cucumber beetle, *Diabrotica vittata* Fabr., was troublesome on cucumbers, squashes and melons at the Station farm at Mount Carmel. They were reported as injuring melons and early squash at Cannondale, July 7, where from two to four leaves had been injured in every hill; also early squash at Westport and Ridgefield, and cucumbers at Westport, July 6 and 7. They may be controlled by a spray of lead arsenate and Bordeaux mixture, by a dust of calcium arsenate and lime or by one of the fluosilicates.

Asparagus beetles, *Crioceris asparagi* Linn., and *C. 12-punctata* Linn., were as abundant as usual.They were reported as few from Norwich and Pawcatuck, May 11, and Southington, May 13. They were reported as abundant and causing considerable damage at Westport, July 6, and at Ridgefield, July 7. In my own garden,

I was able to kill the grubs readily by a spray of Black Leaf 40 (2 teaspoons in a gallon of water).

The green cabbage worm, *Pontia rapae* Linn., was present in the usual abundance and was reported from Westport, Ridgefield, and East Danbury on July 7. It was also plentiful in Hamden.

Reports were few regarding injury by the cabbage maggot, *Hylemyia brassicae* Bouché. An acre field of cabbage and cauliflower at Westport, July 6, showed about 60 per cent injury, and some injury to cabbage and cauliflower was reported from Cheshire as early as May 31. There were 150,000 plants around New Haven, with a loss of 60 per cent on account of the cabbage maggot.

The zebra caterpillar, *Mamestra picta* Harris, was found feeding upon cabbage leaves at Westport, July 6.

The garden flea hopper, *Sminthurus hortensis* Fitch, caused considerable injury to young seedlings. On April 21, the hoppers injured tobacco plants in frames at Hockanum, and May 4, vegetable plants in frames at Westport. They also attacked spinach, lettuce, beans, and cucurbits at the Station farm at Mount Carmel. They were easily controlled by dusting with lead arsenate.

The gray field slug, *Limax agrestis* Linn., was received from Middletown, July 7.

The seed corn maggot, *Hylemyia cilicrura* Rond., was received from Franklin July 21, where it caused injury to potato. Many fields of early sweet corn had to be planted over, and in some cases, planted over twice on account of this insect. The margined blister beetle, *Epicauta marginata* Fabr., feeding on potato in New Haven, was sent to the Station July 26.

The carrot rust fly, *Psila rosae* Fabr., is present in Connecticut. Parsnips injured by this insect were received from Winsted, March 25, and others were dug from my own garden at nearly the same date. No good means of control can be recommended. The squash borer, *Melittia satyriniformis* Hubn., was present as usual and caused considerable injury. Specimens were received from West Haven, August 8. At the Station farm at Mount Carmel, Dr. Friend was able to obtain a good crop of Hubbard squashes by the method of cutting out the borers and covering the vines so that they could make new roots.

The stalk-borer, *Papaipema nitela* Guen., was very common, and though it may burrow in any herbaceous stem, nearly all specimens sent to the Station were in corn. The records follow: Trumbull, July 6; Hamden, July 21; Higganum, July 23; South Britain, July 25; Salem, July 28; Clintonville, August 9; Pomfret, August 19. Little can be done for the control of this pest other than to destroy each borer when discovered.

The corn ear worm, *Heliothis obsoleta* Fabr., was reported only a few times and evidently was less abundant than in some seasons.

One grower reported finding it on his corn much earlier in the season than he had ever seen it before.

The onion maggot, *Phorbia ceparum* Meigen, was reported as causing 20 per cent injury to sets in Westport, July 6. On the same date a field of sets in Westport showed that the onion thrips, *Thrips tabaci* Lindeman, had just begun to cause injury.

Aphids on carrots and parsnips were reported from Westport on July 6, and on carrots and beets from Brookfield and East Danbury on July 7. As specimens were not received or identified, the specific nature or names of the aphids cannot be given. Mr. Peckham reports a total loss of two acres of young carrots from aphid attack and the yield from three acres of parsnips reduced 50 per cent.

The potato aphid, *Macrosiphum solanifolii* Ashm., was sufficiently abundant to curl the leaves of potato at Westport July 6 and probably the same species on tomato was observed at Cannondale July 7. Reports were received of this aphid on potato at Milford, July 19, and later from Middletown, Canterbury, Hebron, Hartford, East Hartford, Wethersfield, and Norwich.

The spinach aphid, *Myzus persicae* Sulz., was also abundant on nearly all kinds of truck crops. Aphids were reported from Norwich as attacking ruta bagas but the plants were not seriously injured by them.

These aphids can all be controlled artificially by nicotine applied either as a spray or as a dust. Treatment at the right time may be profitable on certain crops, but in other cases the treatment may cost more than the value of the crop, or the plants may have been so seriously injured before treatment that they do not recover. Consequently treatment cannot be recommended in all cases, but depends upon conditions, and the final decision whether or not it will pay to spray or dust must rest with the grower.

The pea aphid, *Illinoia pisi* Kalt., caused much injury to peas in various portions of the State. Damage varying from 15 to 20 per cent was reported by Mr. Wilkinson from Westport, Ridgefield, and East Danbury, on July 7.

Shade and Forest Tree Insects

The fall canker worm, *Alsophila pometaria* Harris, has already been mentioned under "Fruit Insects" as being unusually abundant at "Point O' Woods," East Lyme, where the native woodland growth was almost completely stripped of leaves over a small area.

The fall webworm, *Hyphantria cunea* Drury, has also been mentioned under "Fruit Insects" as occurring in usual numbers throughout the State. Specimens were received from Lyme, August 13, and from New Haven, August 18. It was also ob-

served in many portions of the State but particularly in Granby and Putnam.

The elm leaf beetle, *Galerucella xanthomelaena* Schrank, was not so prevalent as usual, though some feeding by the larvae was noticed on small trees in New Haven. Specimens were received from New Haven, July 18, and from Norwich, August 2. As there was abundant moisture during the time of pupation in both 1926 and 1927, there was ample opportunity for the white fungus to attack the pupae, and probably the elm leaf beetle will not be prominent in 1928.

The European elm case bearer, *Coleophora limosipennella* Dup., was received from Norwich, August 2. The small caterpillars make rectangular mines in the leaf, and these areas turn brown, giving the leaves a spotted appearance. Spraying with lead arsenate is probably the best remedy.

The birch skeletonizer, *Bucculatrix canadensisella* Chamb., was less abundant in 1927 than in 1926, and is apparently on the wane, though the larvae were present on birch trees around New Haven. No trees were observed which had turned brown from its attack.

The imported birch leaf miner, *Fenusa pumila* Klug, was present throughout the State and was observed in New Haven, Hamden, Southbury, Woodbury, Sherman and Granby. Specimens were received from New Haven, August 17.

The leopard moth, *Zeuzera pyrina* Linn., is frequently observed in shade trees, though not nearly as destructive as it was fifteen years ago. Specimens were received from East Haven, November 14.

The white-marked tussock moth, *Hemerocampa leucostigma* S. & A., was present as usual throughout the State, though not especially abundant. Specimens were received from New Haven, August 1.

The white pine weevil, *Pissodes strobi* Peck, was present in usual numbers throughout the State and killed the leaders of many young white pine trees growing in sunny places. Trees growing under shade are less apt to be injured. Specimens were received from Stafford Springs, September 10.

Pine sawflies were observed in a number of cases. Specimens of the imported pine sawfly, *Diprion simile* Hartig, were received from New Haven, September 15, on Scotch pine. Another species, *Neodiprion pinetum* Norton, was received from Mount Carmel, October 8. Spraying with lead arsenate is the remedy.

Specimens of the pitch-mass borer, *Parharmonia pini* Kellicott, were received from Farmington, September 30. It seldom causes serious injury, and no practical method of control has been discovered.

The European pine shoot moth, *Rhyacionia buoliana* Schiff., is apparently spreading in the State and is found chiefly on red pine.

What seemed to be this pest was received from Stafford Springs, September 27, and from Rainbow, November 23.

Another pine insect, *Tetralopha robustella* Zell., on red pine, was received from New Haven, September 29. The larvae are brown, striped lengthwise with darker brown, and they live in silken tubes in globular masses of frass. The masses are sometimes two inches or more in diameter. This insect is regarded as being somewhat rare, and can hardly be considered a pest.

The locust leaf miner, *Chalepus dorsalis* Thunb., was more abundant than usual, and black locust and rose acacia throughout the State had the leaves mined by the larvae. These leaves afterward turned brown as though scorched by a fire. This injury was more noticeable in Windham County than elsewhere.

The imported willow leaf beetle, *Plagiodera versicolora* Laich., was received from Greenwich, September 10. This insect has now spread throughout the State and willow leaves are skeletonized by the larvae. A spray of lead arsenate is the remedy.

The poplar and willow curculio, *Cryptorhynchus lapathi* Linn., was received from New Haven, June 7. The larvae were very abundant in some large "pussy willows" growing in the back yard. The trees were ruined.

Girdled pine twigs were received from Eastford, May 16. Apparently this was the work of the pales weevil, *Hylobius pales* Herbst.

The terrapin scale, *Lecanium nigrofasciatum* Perg., on the small twigs of silver maple, was received from Waterbury, October 26.

The tulip tree scale, *Toumeyella liriodendri* Gmel., is common on the lower branches of the tulip tree, sometimes killing the branches. Specimens were received from Hamden, July 26, and from Middlebury, October 26. The young are hatched in September and may easily be killed by a spray of lime-sulphur or a miscible oil applied as soon as the leaves drop.

The European lecanium, *Lecanium corni* Bouché, a species now common in the United States, infesting nearly all kinds of trees and shrubs, was received from Hazardville, June 21, on oak.

The pit-making oak scale, *Asterolecanium variolosum* Ratz., a species imported from Europe and usually found on golden oak, *Quercus robur*, in nurseries, or planted on private grounds, was received March 12 from Woodbridge, on the native chestnut oak.

The somewhat rare spruce bud scale, *Physokermes piceae* Schr., was received from Kensington, June 7.

The elm scale, *Gossyparia spuria* Modeer, continues to be prevalent on young trees, and is found in nurseries. Specimens were received from New Haven, June 27.

One of the oak gall scales, *Kermes* sp., was received from New Haven, July 25, and was found to be quite abundant on oaks in one nursery.

The pine leaf scale, *Chionaspis pinifoliae* Fitch, was received from Hartford, January 21, and from Norwalk, September 19.

The spruce gall aphid, *Adelges abietis* Linn., is very prevalent on Norway spruce trees in nurseries, ornamental and forest plantings. Specimens were received from New Haven, April 13; Southington, April 16; Winsted, June 4; Avon, July 2, and Naugatuck, July 6. Another species which may be called the blue spruce gall aphid, *Gillettea cooleyi* Gillette, makes large galls on the Colorado blue spruce. Specimens were received from Thompson, May 28. A variety of the latter, known as *Gillettea cooleyi* var. *coweni* Gillette, infests Douglas fir but does not form galls. Specimens were received from Middlebury, July 2.

The larch woolly aphid, *Adelges strobilobius* Kalt., was received from Danbury, July 6. The pine bark aphid, *Adelges pinicorticis* Fitch, was received from Derby, May 1, and Hamden, June 1. Both of these insects are woolly aphids and do not form galls, though closely related to the gall-forming species.

Aphids were exceedingly abundant on nearly all kinds of trees and shrubs. The beech woolly aphid, *Phyllaphis fagi* Linn., was received from Milford, June 17. In general, a nicotine spray is perhaps the best method of controlling aphids.

The spruce mite, *Paratetranychus ununguis* Jacobi, is the cause of much injury to spruce and other conifers, and seems to be increasing in prevalence. Specimens were received from Old Lyme, July 9. One of the best remedies is to spray thoroughly with linseed oil emulsion.

The maple leaf bladder gall, *Phyllocoptes quadripes* Shimer, is common on leaves of the silver maple, and specimens were received from Norwalk, May 23, Hamden, May 31, and Danbury, June 23. Spraying the dormant trees in early spring with lime-sulphur is a remedy.

Insects Attacking Ornamental Shrubs and Plants

Aphids were abundant on nearly all kinds of ornamental plants during the summer.

The juniper webworm, *Dichomeris marginellus* Fabr., caused injury to low junipers here and there, and specimens were received from Cheshire, April 19. Spraying heavily with lead arsenate is the remedy.

The abbot sphinx, *Sphecodina abbotii* Swain., was observed in several localities, the larvae feeding upon Virginia creeper. Specimens were received from Cos Cob, July 23, and from New Haven and Putnam, August 2. Hand picking is the usual method of control, but a spray of lead arsenate will protect the vines from being defoliated.

The stalk borer, *Papaipema nebris* Guen., which has been mentioned under vegetable insects, is also injurious to dahlia, lily, larkspur, hollyhock, and other herbaceous stems. Specimens in dahlia were received from South Kent, August 4.

The iris borer, *Macronoctua onusta* Grote, was present in about the usual numbers. The Entomologist found it in his own garden, and specimens were received from Old Saybrook, July 6. The remedy is to gather and burn the old leaves in late fall or early spring, to kill the eggs.

The black vine weevil, *Brachyrhinus (Otiorhynchus) sulcatus* Fabr., caused some injury to Taxus plants in a nursery at New Canaan where it was observed on August 10. The larvae feed upon the roots and on this date the adults were emerging and were feeding somewhat upon the leaves.

Serious injury to boxwood by the boxwood leaf miner, *Monarthropalpus buxi* Labou., was reported from Westport, on June 13. The adults were just emerging. One of the best remedies seems to be molasses and nicotine solution, using cheap molasses, one part in four parts water, and adding nicotine sulphate at the rate of one part in 500 parts of the spray material. The first application should be made at the time the first adult flies emerge, and the foliage should be kept covered for three weeks, spraying after each rain and directing the spray against the under side of the leaves. An application once each week is sufficient in fair weather.

The strawberry leaf roller, *Ancylis comptana* Frölich, was very abundant and caused injury to roses in many localities in the State. Unopened buds and tender leaves were eaten by the larvae during June and July. In some gardens around New Haven, a large proportion of the rose buds were injured by this insect. Probably spraying with lead arsenate would be effective.

The common red spider, *Tetranychus bimaculatus* Harvey, was quite prevalent on hardy phlox during the summer and caused the leaves to turn yellow and later many turned brown and dropped. Specimens were received from Old Saybrook, July 6, East Haven, July 7, and Plainfield, July 16. In severe cases it may be advisable to underspray with linseed oil emulsion.

The cyclamen mite, *Tarsonemus pallidus* Banks, continues to be a troublesome pest in garden and greenhouse. It attacks cyclamen, snapdragon, and chrysanthemum in the greenhouse and injures larkspur and garden balsam, *Impatiens Balsamina,* in the flower garden. Specimens on larkspur were received from East Haven on August 11. This pest may be controlled, though perhaps not wholly eradicated, by spraying twice a week until the plants blossom with nicotine solution, one part in 500 parts water, with a little soap added.

The rhododendron lace bug, *Leptobyrsa rhododendri* Horvath, was received from Norfolk, September 29. This insect is now

rather prevalent on rhododendron and mountain laurel, and sucks the sap from the under sides of the leaves. The remedy is to spray with nicotine solution and soap soon after the young nymphs appear.

Miscellaneous Insects

The Asiatic beetle, *Anomala orientalis* Waterhouse, still exists in the Westville section of New Haven, though the pest has been greatly reduced by the soil treatment. It has developed during the past season in certain lawns not injured heretofore. As the insect is rather abundant in Westchester County and on Long Island, New York, the idea of eradicating it from New Haven seems less important than formerly when the local area was the only known infestation in the United States. The eradication program, on account of its great cost, will probably be modified toward a plan of experiment and control.

A species of silver fish or bristle-tail, *Thermobia domestica* Pack., causes considerable damage in dwelling houses, particularly by eating the paste from book covers. Specimens were received from Greenwich, October 24.

The European hen flea, *Ceratophyllus gallinae* Schrank, caused considerable discomfort by biting human beings in Madison. This is the first record of the occurrence of this insect in Connecticut, though it has been recognized in other states and is probably widely distributed in this country. The matter is discussed more fully on another page of this report.

Convention of Entomological Workers

The fourth annual convention of entomologists working in Connecticut was held at the Station on Friday, November 4, 1927. The program was similar to those of preceding conventions and included subjects of vital interest to Connecticut entomologists. Those from outside the State who gave papers or addresses were: Dr. H. C. Huckett, Riverhead, N. Y., A. F. Burgess, Melrose Highlands, Mass., D. W. Jones, Arlington, Mass., J. L. King, Moorestown, N. J., and Professor C. C. Hamilton, New Brunswick, N. J. About 43 attended this meeting. Luncheon was obtained at the Yale Dining Hall. The program was as follows:

Program

A. M.

10:00 Greeting.
W. L. Slate, Director Experiment Station, New Haven.

10:15 Present Organization of Entomological Work in Connecticut.
Dr. W. E. Britton, New Haven.

10:30 A Contribution to Our Knowledge of Cucumber Beetles.
Dr. H. C. Huckett, Riverhead, N. Y.

10:45 Notes on the Life History of the Asiatic Beetle.
Dr. R. B. Friend, New Haven.
11:00 A General Survey of Gipsy Moth Conditions.
A. F. Burgess, Melrose Highlands, Mass.
11:40 Gipsy Moth Conditions in Connecticut.
John T. Ashworth, Danielson.
11:50 Spread of the European Corn Borer and the Establishment of Imported Parasites.
D. W. Jones, Arlington, Mass.
12:30 Present Status of the European Corn Borer in Connecticut.
M. P. Zappe, New Haven.

P. M.

12:45 Luncheon.
2:00 The Japanese Beetle and the Parasites Which Have Been Established in This Country.
J. L. King, Moorestown, N. J.
2:45 Japanese Beetle Conditions in Connecticut.
J. Peter Johnson, New Haven.
3:00 Some Notes on the Life History, Habits, and Methods of Control of *Aserica castanea*.
Prof. C. C. Hamilton, New Brunswick, N. J.
3:45 The Plum Curculio in Connecticut Apple Orchards.
Dr. Philip Garman, New Haven.
4:00 Mosquito Elimination Work of the Season in Connecticut.
R. C. Botsford, New Haven.

The following were present: John T. Ashworth, Danielson, Conn.; C. H. Batchelder, Arlington, Mass.; George R. Biecher, West Haven, Conn.; H. L. Blaisdell, Melrose Highlands, Mass.; R. C. Botsford, New Haven, Conn.; A. I. Bourne, Amherst, Mass.; W. E. Britton, New Haven, Conn.; A. F. Burgess, Melrose Highlands, Mass.; W. A. Collins, New Milford, Conn.; I. D. Dobroscky, Yonkers, N. Y.; W. O. Filley, New Haven, Conn.; R. B Friend, New Haven, Conn.; Philip Garman, New Haven, Conn.; C. C. Gillette, Storrs, Conn.; Harold C. Hallock, Westbury, N. Y.; C. C. Hamilton, New Brunswick, N. J.; Mr. and Mrs. Albert Hartzell, Yonkers, N. Y.; H. W. Hicock, New Haven, Conn.; August E. Hooghkirk, New Haven, Conn.; Mr. and Mrs. J. L. Horsfall, Yonkers, N. Y.; H. C. Huckett, Riverhead, N. Y.; Mr. and Mrs. D. W. Jones, Arlington, Mass.; J. Peter Johnson, New Haven, Conn.; G. H. Lamson, Jr., Storrs, Conn.; J. L. King, Moorestown, N. J.; J. A. Manter, Storrs, Conn.; S. E. May, Canaan, Conn.; J. A. McEvoy, Putnam, Conn.; B. W. McFarland, New Haven, Conn.; W. B. Mix, Greenwich. Conn.; W. D. Munson, South Britain, Conn.; R. C. Newton, Storrs, Conn.; O. C. Otis, Winsted, Conn.; C. C. Plummer, Storrs, Conn.; F. C. Rich, Ansonia, Conn.; Milton E. Rydberg, Yonkers, N. Y.; J. F. Townsend, New Haven, Conn.; B. H. Walden, New Haven, Conn.; R. A. Vickery, Stratford, Conn.; M. P. Zappe, New Haven, Conn.

INSPECTION OF NURSERIES IN 1927

W. E. Britton and M. P. Zappe

The regular annual inspection of nurseries was commenced July 1 and finished in September, except for a few new nurseries which were inspected afterwards, the final inspection for 1927 being made

on December 2. As in former years, this work was in charge of Mr. Zappe, who was assisted by Messrs. J. L. Rogers, J. F. Townsend, A. P. Harger, and H. B. Bender. In a few cases assistance was rendered by E. M. Stoddard, B. H. Walden, John T. Ashworth, and W. E. Britton.

Mr. Bender is a botanist who was employed temporarily for the purpose, in order to give special attention to such plant diseases as might occur in the nurseries.

In addition to the inspections made by the nursery inspectors, the gipsy moth scouts were instructed to make careful examinations for gipsy moth eggs in and around all nurseries in the infested area, and in case any were found, to report at once to the office. No gipsy moth infestations were discovered in or near any nursery in 1927. Also the pine blister rust scouts under Mr. J. E. Riley examined all nurseries where the blister rust was reported by the nursery inspectors.

On the whole, the nurseries were in as good condition as usual except that aphids were unusually abundant and were present on many kinds of plants not usually found infested. Some nurserymen have not yet obtained satisfactory control of the spruce gall aphid, though each has been supplied with literature giving the life history of the insect and methods of treatment, based upon the experiments of Dr. R. B. Friend of this Station.

In 37 nurseries no important pests were found. Following is a list of insects and plant diseases found in nurseries during the annual inspection of 1927, together with the number of nurseries infested by each:

PESTS FOUND IN NURSERIES IN 1927

Number of nurseries uninfested 37

INSECTS

Name	No. Nurseries	Name	No. Nurseries
Aphids, apple, green	36	Aphids, on pear	4
woolly	43	pine	1
Aralia	11	plum	6
on ash	1	raspberry	1
birch	10	rose	8
cherry	5	spiraea	9
Crataegus	6	spruce	4
currant	5	sumac	2
elm	1	syringa	1
Euonymus	1	tulip tree	1
honeysuckle	1	*Viburnum*	4
hydrangea	1	walnut	2
larch	1	willow	6
lupine	1	spruce gall, *Adelges abietis*	64
maple	4	*Gillettea cooleyi*	18
mountain ash	9	larch woolly, *Adelges*	2
oak	2	pine bark	21
peach	1	woolly, on purple beech	1

Name	No. Nurseries
Apple and thorn skeletonizer	22
Birch leaf miner	34
Borer, bronze birch	2
in apple	1
ash	1
lilac	1
linden	1
poplar	9
rose	1
willow	4
Curculio, walnut	2
Currant worm, imported	4
Elm leaf beetle	4
European pine shoot moth	1
Fall webworm	15
Janus abbreviatus	3
Juniper webworm	16
Lace bug, on quince	1
rhododendron	32
Leafhoppers, on apple	60
boxwood	2
cherry	1
Crataegus	1
elm	1
lilac, Persian	1
maple	3
mountain laurel	2
pear	1
quince	1
rose	9
Leaf miner in alder	1
arborvitae	7
boxwood	5
Catalpa bungei	7
columbine	1
elm	1
magnolia	1
maple	2
Mealy bug on *Taxus*	1
Midge on silver maple	4
Mite, European red	11
pear leaf blister	39
spruce	43
on *Amelanchier*	1
arborvitae	11
ash	1
birch	1
box elder	1
Clethra alnifolia	1
fir	1
juniper	5

Name	No. Nurseries
Mite, on maple	4
oak	6
phlox	4
pine	1
plum	1
Mite, on *Retinospora*	2
walnut	1
willow	1
galls on buttonbush	1
Oriental peach moth	23
Pear psylla	24
slug	24
Pine tube moth	1
Poplar flea beetle, *Crepidodera helxines*	2
leaf beetle, *Lina scripta*	2
Red-humped caterpillar	4
Rose, leaf tyers on	1
Sawfly, imported, *Diprion simile*	6
Scale, elm	7
elm scurfy	3
euonymus	3
juniper	2
Lecanium on arborvitae	1
maple	1
oak	1
oak gall	1
oyster-shell	45
pine leaf	6
rose	8
San José	16
scurfy	1
terrapin	1
tulip tree	4
on magnolia	1
Retinospora	1
Shot-hole borer	1
Sphinx caterpillars	1
Spiny elm caterpillar	1
Spittle bug on arborvitae	1
juniper	2
Stalk borer	1
Tarnished plant bug	3
Tent caterpillar	1
Tulip tree leaf gall	1
White pine weevil	17
Willow curculio	1
leaf beetle, imported *Plagiodera versicolora*	11
Yellow-necked caterpillar	1

PLANT DISEASES

Name	No. Nurseries	Name	No. Nurseries
Anthracnose on cherry	8	Leaf spot on strawberry	24
currant	24	Mildew on apple	31
grape	5	*Catalpa*	33
Apple scab	44	cherry	1
Black knot	1	dogwood	1
rot on apple	49	grape	32
cherry	1	honeysuckle	1
quince	6	lilac	13
Brown rot	9	peach	2
Canker, poplar	39	pear	2
Crown gall	6	phlox	9
Fire Blight	6	raspberry	1
Leaf blotch on rose	77	*Rhus canadensis*	1
on *Ampelopsis*	1	rose	35
spot on *Catalpa*	30	Symphoricarpus	1
cherry	1	Raspberry cane blight	1
elm	2	mosaic	21
horse chestnut	2	Rust on apple	72
iris	11	cedar	12
linden	1	*Crataegus*	3
maple	7	juniper	17
—tar spot—	1	quince	5
mountain ash	5	willow	1
pear	1	White pine blister, on *Ribes*	9
phlox	15		

From an examination of the preceding list, it will be seen that of the insects, the spruce gall aphid was found in more nurseries (64) than any other, though followed rather closely by apple leaf-hoppers (60), oyster-shell scale (45), woolly apple aphid (43), spruce mite (43), pear leaf blister mite (39), green apple aphid (36), birch leaf miner (34), rhododendron lace bug (32), pear psylla (24), pear slug (24), Oriental peach moth (23), apple and thorn skeletonizer (22), pine bark aphid (21), *Gillettea cooleyi* (18), white pine weevil (17), San José scale (16), juniper web-worm (16), and fall webworm (15).

Of the plant diseases found in nurseries, leaf blotch on rose headed the list (77). Others in order of number of nurseries found infested were as follows: rust on apple (72), black rot on apple (49), apple scab (44), poplar canker (39), mildew on rose (35), mildew on *Catalpa* (33), mildew on grape (32), mildew on apple (31), leaf spot on *Catalpa* (30), anthracnose on currant (24), leaf spot on strawberry (24), raspberry mosaic (21), rust on juniper (17), leaf spot on phlox (15), mildew on lilac (13), rust on cedar (12), and white pine blister rust on *Ribes* (9).

On account of the abundant rainfall certain fungous diseases like mildews were apparently more abundant than usual.

In order to show the prevalence of certain nursery pests in 1927 as compared with 1926 and the preceding seasons, the record of them for the past seven years is given in the following table:

SEVEN-YEAR RECORD OF CERTAIN NURSERY PESTS

	1921	1922	1923	1924	1925	1926	1927
Oyster-shell scale	36	44	42	44	38	39	45
San José scale	28	19	20	32	32	19	16
Spruce gall aphids*	31	21	28	40	27	42	82
White pine weevil	1	19	17	5	5	8	17
Apple and thorn skeletonizer		1	18	2	8	9	22
Poplar canker	21	31	34	25	34	32	39
Pine blister rust (on *Ribes*)	2	9	6	8	7	9	9
Nurseries uninfested	36	36	32	33	34	46	37

*Includes both *Adelges abietis* and *Gilletiea cooleyi*.

It should be understood that the figures in the preceding table are not strictly comparable because of the greater number of nurseries since the new law went into effect in 1925. Thus though the number of infested nurseries is greater, the actual percentage may be considerably less.

NUMBER AND SIZE OF NURSERIES

The number of nurseries in Connecticut has increased each year. The list for 1926 contained 162 names. The list for 1927 contains 191 names. Of the 191 separate nurseries in the State, a classification on account of size may be made as follows:

Nurseries containing 50 acres or more	15
" " between 10 and 50 acres	19
" " " 5 and 10 "	27
" " " 2 and 5 "	52
" " 1 acre or less	78
	191

During the year 1927, 208 nursery inspections were made. The list of nursery firms on the following pages contains 191 names; 15 were inspected twice, once in the spring and again in the fall, and two other nurseries which were inspected failed to qualify in order to receive certificates. Thus 206 regular certificates have been issued, and 206 duplicate certificates have been furnished for filing in other states.

The owners of two small nurseries failed to register before July 1, so, according to Section 2, Chapter 265, Public Acts of 1925, each was charged five dollars as the estimated cost of inspection. This would have been more had it been necessary to make a special trip to inspect each nursery. The total amount of ten dollars ($10.00) was sent to the State Treasurer on March 31.

The total area of Connecticut nurseries is about 2,654 acres. The figures were taken from the owners' estimates on the registration cards, except in cases where the acreage was not given on the cards it was estimated by the inspector. All nurseries of less

than an acre are listed as one acre, and where fractions are given, the next whole number is recorded. This list of nursery firms for 1927 is as follows:

NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1927

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Alius, Adolf	Stamford	1	Aug. 19	386
Allen, Henry L.	North Stonington	1	Aug. 29	413
Amelunxen & De Wyn	Yalesville	3	Aug. 16	370
Babski, J. S.	Southington	2	Apr. 9	337
Barnes Bros. Nursery Co.	Yalesville, No. Haven and Durham	150	Aug. 11	352
Barnes Eastern Nurseries	Wallingford	15	Aug. 16	366
Barnes Nursery & Orchard Co.	Wallingford	50	Oct. 17	503
Barton, Robert	Hamden	1	Sept. 10	468
Benbow, A.	Norfolk	1	Sept. 22	489
Berkshire Nurseries (C. B. Myers, Mgr.)	Milford	1	Sept. 10	470
Bertana, Louis	Glenbrook	1	Aug. 19	387
Bertolf Bros.	Greenwich	45	July 22	345
Birchell, George A. (2)	Stonington	1	Aug. 29	414
Booy, H. W.	Yalesville	3	Aug. 16	369
Botsford, R. C.	East Haven	1	Sept. 9	448
Brainard Nursery & Seed Co.	Thompsonville	10	Aug. 26	410
Braley & Co., S. A.	Burnside	3	Aug. 16	367
Branford Nurseries	Branford	4	Aug. 31	429
Bretschneider, A.	Danielson	1	Aug. 30	420
Bridgeport Hydraulic Co.	Bridgeport	200	Nov. 2	510
Bristol Nurseries, Inc.	Bristol	50	Aug. 19	383
Brooklawn Conservatories	Bridgeport	1	Nov. 16	513
Brouwer's Nurseries	New London	2	Aug. 22	400
Brown, E. M.	Hartford	1	Sept. 7	441
Buckley, Walter E.	Groton	1	Aug. 29	417
Bulpitt, Henry F.	Darien	5	Aug. 19	385
Burke, P. J.	Rockville	1	Aug. 16	368
Burr, Morris L.	Westport	1	Aug. 15	363
Burr & Co., C. R.	Manchester, Ellington, and Durham	320	Aug. 5	347
Burroughs, Thomas E.	Deep River	4	Aug. 13	355
Burwell, E. E.	New Haven	1	Sept. 9	450
Cant, Alexander	Springdale	1	Sept. 7	439
Cardarelli, E. J.	Cromwell	2	Aug. 31	428
Carolla, John (2)	Hamden	1	Nov. 23	520
Case, Louis L.	Simsbury	1	Sept. 9	451
Chapman, Anna L.	North Stonington	1	Sept. 7	445
Chapman, C. B.	Groton	1	Aug. 22	399
Chippendale Nurseries (2)	Old Lyme	1	Aug. 22	402
Clark, Raymond H.	Milford	1	Sept. 10	467
Clinton Nurseries (Warren W. Richards, Prop).	Clinton	6	Nov. 29	523
Clyne, George A. (2)	Middlebury and Woodbury	20	Oct. 19	507
Conine Nursery Co.	Stratford	50	Aug. 8	350
Conn. Agricultural College (Prof. S. P. Hollister)	Storrs	1	Sept. 20	484

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Conn. Agr. Expt. Station (W. O. Filley, Forester)	New Haven, Hamden, Cheshire and Norwich	5	Sept. 10	466
Conn. Valley Nurseries	Manchester	2	Aug. 8	351
Cooper's (Stratford Florist Co.)	Stratford	1	Dec. 6	527
Corrigan, James J.	West Haven	1	Sept. 7	446
Cragholme Nursery (2)	Greenwich	6	Aug. 25	408
Cromie, G. A.	New Haven	2	Oct. 17	504
Dallas, Inc., Alexander	Waterbury	3	Nov. 19	518
Dawson, William A.	Willimantic	1	Sept. 19	482
Dowd, Inc., F. C.	Madison	2	Dec. 30	533
Dunlap, Daniel S.	Cromwell	3	Aug. 15	362
Eager, Edward M.	Bridgeport	1	Sept. 27	493
East Rock Nursery Co (S. Palmieri, Prop.)	New Haven	1	Sept. 30	497
Eells & Sons	Manchester	1	Aug. 22	397
Elfgren, I. P. & Sons	East Killingly	1	Aug. 22	395
Elm City Nursery Co. (Woodmont Nurseries, Inc.)	Woodmont, Milford and Orange	120	Sept. 8	447
Elm Grove Cemetery Association	Mystic	1	Sept. 13	473
Ensign-Bickford Co., (S. W. Eddy, Supt.)	Avon	10	Oct. 26	508
Evergreen Nursery Co.	Wilton	15	Aug. 18	381
Fairty, C. H. (2)	New Canaan	2	Nov. 23	522
Farmington Valley Nursery (Harry D. Wilcox, Prop.)	Avon	2	Sept. 27	494
Flower City Rose Co.	Manchester	1	Aug. 20	390
Fraser's Nurseries & Dahlia Gardens	Willimantic	2	Sept. 29	495
Galligan, C. W.	North Haven	2	Sept. 16	480
Gardner, R. H.	Rocky Hill	60	Aug. 15	358
Geduldig's Greenhouses	Norwich and Ledyard	3	Sept. 10	460
Giuliano, John S.	Wethersfield	1	Sept. 9	454
Glen Terrace Nurseries (Jas. H. Everett, Prop.)	Mt. Carmel	24	Dec. 5	526
Golden Hill Nurseries (Andrew Johnson, Prop.)	Shelton	2	Sept. 21	488
Goodwin Nurseries (2)	Bloomfield	7	Sept. 7	440
Hansen, Peter	Fairfield	2	Aug. 30	419
Hawes, F. M.	West Hartford	1	Sept. 15	477
Hearn, Thomas H.	Washington	2	Sept. 21	486
Heath & Co.	Manchester	2	Aug. 5	349
Hill Top Nursery (F. W. Langstroth, Prop.)	Danbury	4	Aug. 30	425
Hilliard, H. J.	Sound View	1	Sept. 9	455
Hiti Nurseries (J. H. Bowditch, Prop.)	Pomfret Center	8	Aug. 16	365
Holcomb, Irving	Granby	1	Aug. 18	380
Holdridge, S. E.	Ledyard	4	Aug. 12	354
Horan & Son, James	Bridgeport	1	Nov. 10	511
Houston, Byron D.	Mansfield	15	Oct. 28	509
Hoyt's Sons Co., Inc., Stephen	New Canaan	500	Aug. 17	377
Hull, Curtis M.	Wallingford	1	Aug. 16	375
Hunt & Co., W. W.	Hartford	8	Aug. 31	427

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Huntoon, Gerald W.	Rocky Hill	1	Aug. 22	405
Intravaia, Joseph	Middletown	2	Aug. 19	384
Jennings, G. S.	Southport	1	Aug. 15	364
Johnson, Tom (2)	Stratford	1	Aug. 30	423
Jones, William	Norwalk	1	Aug. 29	411
Judd, T. H. (2)	Danbury	1	Dec. 31	534
Kauser, Alice (2)	Norwalk	1	Aug. 17	379
Kelley & Son, James J.	New Canaan and Darien	6	Nov. 17	516
Kerner, Eugene	Woodbury	8	Dec. 21	529
Keystone Nurseries (H. H. Kellner, Prop.)	Danbury	1	Sept. 12	471
Leghorn, John	Cromwell	7	Aug. 15	361
Lewis & Valentine, Inc.	Darien	11	Sept. 10	463
Liljenstein, Carl (2)	New London	1	Aug. 22	401
Lundberg, E. A. (2)	Springdale	1	Aug. 22	404
Lynch, Mrs. John H.	Ridgefield	5	Dec. 28	532
Malavasi, Sam	Woodbridge	3	Sept. 9	457
Mallett Co., George A.	Bridgeport	5	Sept. 7	443
Maplewood Nursery Co. (T. H. Peabody, Mgr.)	Norwich	2	Nov. 21	519
Marigold Farm (Henry Kelley, Prop.)	New Canaan	10	Sept. 20	483
Marshall, Robert	Wethersfield	1	Sept. 10	461
Mayapple Nurseries (Paul M. Barrows, Prop.)(2)	Stamford	1	Sept. 10	462
Maynard & Gadbois (2)	Old Lyme	1	Sept. 7	442
McConville, John	Manchester	1	Aug. 22	396
Meier, A. R. (2)	West Hartford	1	Nov. 23	521
Merwin Lane Nursery (J. W. Marvin, Jr., Prop.)	Fairfield	5	Aug. 23	406
Middeleer, Inc.	Darien	10	Sept. 7	444
Millane Nurseries	Cromwell	5	Sept. 9	456
Minge, G. H.	Rocky Hill	1	Aug. 26	409
Moraio Bros.	Stamford	2	Nov. 16	514
Morgan, W. F. (Westerly, R. I.)	North Stonington	3	Aug. 29	416
Moulthrop, William	Watertown	3	Sept. 10	464
Mount Airy Gardens (R. L. Wilson, Prop.) (2)	North Stamford	1	Aug. 22	403
Mount Carmel Nursery	Mount Carmel	1	Dec. 24	531
New Britain Board of Water Commissioners	New Britain and Southington	50	Sept. 15	478
New Haven Nurseries (Louis A. Soldan, Mgr.)	New Haven	1	Nov. 30	524
New Haven Park Commission (G. X. Amrhyn, Supt.)	New Haven	20	Oct. 5	487
New London Cemetery Association	New London	1	Aug. 29	412
New York, New Haven & Hartford Railroad Co. (C. A. Haggerty)	Stamford	6	Dec. 6	528
Nicolson & Thurston	Litchfield	1	Sept. 2	433
North-Eastern Forestry Co.	Cheshire	56	Aug. 4	346
Norwood Nursery	Hamden	1	Aug. 30	421
Oakland Nurseries	Manchester	2	Aug. 5	348

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Old Orchard Nursery (R. G. Hanford, Prop.)	Norwalk	2	Sept. 20	485
Ostergren, Herbert	Cromwell	2	Aug. 16	373
Outpost Nurseries	Ridgefield	75	Aug. 13	356
Ouwerkerk, D. K.	Yalesville	6	Aug. 16	371
Park Gardens	Bridgeport	1	Nov. 17	517
Pedersen, Anthon	Stamford	1	Sept. 17	481
Pequod Nursery Co.	Yalesville	15	Aug. 11	353
Phelps & V. T. Hammer Co. The J. W.	Branford	2	Dec. 24	530
Pierson, Inc., A. N.	Cromwell	110	Aug. 15	357
Polish Orphanage Farm	New Britain	1	Sept. 26	492
Pomeroy, Edwin C.	New Milford	5	Sept. 2	432
Prospect Nurseries, Inc. (S. C. Hubbard, Prop.)	Cromwell	5	Aug. 15	360
Prudence Seymour Gardens (Mary T. Parfitt, Prop.)	New Milford	1	Sept. 2	435
Reynolds, Stephen	South Norwalk	2	Aug. 22	393
Richmond Gordon L.	New Milford	1	Sept. 9	449
Ridgefield Florist & Nursery Co. (W. Pinchbeck, Prop.)	Ridgefield	3	Sept. 6	437
Rockfall Nursery Co., (Philip Marotta, Mgr.)	Rockfall	75	Sept. 3	436
Rottenberg, Julius	Newington Junction	1	Sept. 13	475
Rushworth, Edwin	Yalesville	1	Aug. 16	372
Russell, C. B.	Newington	1	Nov. 12	512
Sage, Hollister	Woodbury	1	Sept. 9	458
Sargeant, A. R.	Tolland	2	Aug. 15	359
Saxe & Floto	Waterbury	1	Sept. 9	459
Schaeffer Bros.	Ledyard	4	Aug. 22	398
Scheepers, Inc., John	Stamford	14	Aug. 22	392
Schoonman, W. J.	New London	5	Oct. 5	499
Schulze, Charles T.	Bethel	1	Sept. 2	431
Scott's Nurseries	Bloomfield	5	Dec. 2	525
Shelton, P. S.	Fairfield	2	Aug. 30	426
Sierman, C. H.	Hartford	8	Sept. 13	474
Simonson, H. C.	Plainville	2	Sept. 10	465
Snelgrove, S. J.	Windsor	2	Aug. 22	394
South Wilton Nurseries (J. C. Van Heiningen, Prop.)	South Wilton	3	Aug. 20	389
Southport Nursery (Coari & Sons, Props.)	Southport	20	Aug. 22	391
Spring Nurseries (Wallace Barnes Co.)	Bristol	2	Sept. 9	452
State of Connecticut (A. F. Hawes, State Forester)	Simsbury	4	Sept. 9	453
State Street Nursery (John Natyzon, Prop.)	New Haven	2	Sept. 22	490
Steck, Charles A.	Newtown	6	Nov. 17	515
Steck, Charles A. Jr.	Bethel	5	Aug. 25	407
Stratfield Nurseries (George R. Godfrey, Prop.)	Bridgeport	20	Oct. 11	501
Stratford Rose Nursery (John Barrow, Prop.)	Stratford	1	Aug. 30	422
Sunridge Nurseries	Greenwich	7	Oct. 18	506
Szirbik & Co., George	New Haven	1	Sept. 12	472
Tanner's Nursery Co.	Manchester	2	Sept. 1	430

Name of Firm	Address	Acreage	Certificate Issued	No. of Certificate
Thomas Nursery	Hamden	1	Sept. 6	438
Upson, R. E.	Marion	3	Sept. 24	491
Vanderbrook & Son, Charles L.	Manchester	18	Aug. 17	376
Van Wilgen Nurseries	Branford	7	Oct. 7	500
Vasileff, Nicholas	Greenwich	3	Oct. 17	502
Verkade's Nurseries	New London	15	Aug. 29	418
Vidal-Mackintosh, Inc.	Stamford	1	Sept. 30	498
Wallace, A. T.	Wallingford	8	Aug. 16	374
Wayside Farm Gardens (Miss I. E. Aldrich, Prop.)	Thomaston	2	Sept. 2	434
Wegner, C. F.	Noroton Heights	2	Sept. 13	476
Wheeler, C. B.	North Stonington	1	Aug. 29	415
Wild's Nursery, Henry	Greenwich and Norwalk	27	Aug. 18	382
Williams & Holmes	Huntington	1	Aug. 30	424
Wilson & Co., C. E.	Manchester	80	Aug. 20	388
Woodruff, C. V.	Orange	1	Sept. 10	469
Wyllie, David	Whitneyville	1	Sept. 29	496
Yale Landscape Department	New Haven	4	Oct. 17	505
Yale School of Forestry	New Haven	2	Sept. 16	479
Zack & Co., H. J.	Deep River	6	Aug. 17	378
Total 191 nurseries		2654 acres		

Bulletin No. 292, "Some Insects Infesting Nursery Stock in Connecticut," has recently been published and sent to all nurserymen receiving certificates in 1927. This bulletin contains brief descriptions and illustrations of the more common insect pests of nursery stock in Connecticut.

Inspection of Raspberry Plantations

Certain nurserymen and raspberry growers applied for special inspections and certificates in order to enable them to sell plants free from mosaic. Such inspections and certificates are required if raspberry plants are to be shipped into the states of Michigan, Minnesota, New York, and Vermont. Two nursery firms made application for the special inspection and certificates for their raspberry plants, and the inspections were duly made. Certain varieties contained too much mosaic and could not be included, but the following certificates were granted:

Special Certificates on Raspberry Plants

Name of Firm	Address	Variety	Certificate Date of Issue	Certificate Number
Barnes Nursery & Orchard Co	Wallingford	Cuthbert Erskine Park Latham	Oct. 24	16
Conine Nursery Co.	Stratford	La France St. Regis	Oct. 24	15

Nursery Dealers

Chapter 265, Public Acts of 1925, provides that dealers in nursery stock must register each year, on or before March 1, with the State Entomologist, and cite the principal sources of their nursery stock. All dealers' permits are for the remainder of the calendar year and expire on December 31. During the year 80 such dealers have registered and received permits. The list of dealers is on file in the office of the State Entomologist but is not printed in this Report.

Out-of-State Nurserymen

Nurserymen in other states wishing to ship stock into Connecticut are required to file with the State Entomologist signed copies of their nursery inspection certificates and make application for permits to ship stock into the State. These permits are valid only for the periods covered by the certificates placed on file. During the year 213 permits have been issued to nurserymen in other states, but the list of firms receiving them is not printed in this Report.

Parcel Certificates

In addition to the regular inspection and certification of nursery stock, occasionally individuals wish to send shrubs and plants to their friends, and sometimes nurserymen need to ship packages before receiving their regular certificates. Consequently 190 separate parcels of nursery stock have been inspected and package certificates furnished.

Inspection of Narcissus Bulbs

On account of Federal quarantine No. 62, narcissus bulbs grown in Connecticut cannot be shipped into other states unless given two inspections, one in the field in May, and the other after the bulbs have been dug for shipment. In case they are found to be infested with bulb flies or eelworms, they must then be treated. During the year 20,000 such bulbs were inspected and certified.

Inspection of Laurel and Decorative Materials

Considerable decorative material is gathered each year in Connecticut woodlands and shipped into New York City. This is mostly mountain laurel, *Kalmia latifolia*. If gathered within the gipsy moth quarantined area, it is examined by Federal inspectors, and if found clean, is certified for shipment. Much of it is collected outside the quarantined area and yet cannot enter New York without being certified. During the year 230 such certificates were issued.

Inspection of Shelled Seed Corn

On account of the European corn borer having been found in a small portion of Connecticut, certain states would not allow shelled sweet corn for seed to enter unless it had been inspected and certified to be free from bits of cob large enough to carry borers. Therefore a large quantity of such seed corn was inspected as it came through the cleaning mill, and 259 certificate tags were issued.

INSPECTION OF IMPORTED NURSERY STOCK

W. E. Britton and M. P. Zappe

For the past eight years the only nursery stock allowed to enter Connecticut from foreign countries has been entirely rose and fruit tree seedlings for propagation. This material is released at ports of entry; notice of its arrival is sent to this office, and it is inspected at its destination. All other plant material must go to Washington, where it is inspected, and if necessary, fumigated or destroyed. The imported nursery stock entering Connecticut in 1927 was inspected by Mr. Zappe, assisted at rush times by Messrs. B. H. Walden, B. W. McFarland, and J. P. Johnson. The number of shipments, cases, and plants was slightly less than in 1926, but the number of plants has been exceeded only in 1924 and 1926, as the following table shows:

Year	No. of shipments	No. of cases	No. of plants
1920	17	87	814,491
1921	21	126	1,228,560
1922	30	159	1,997,595
1923	35	179	1,981,895
1924	33	313	3,489,170
1925	27	277	2,977,346
1926	32	347	3,443,357
1927	31	321	3,229,915

Though the greatest number of shipments came from Holland, the greatest number of cases and plants came from France, as the following table indicates:

Sources of Imported Nursery Stock, 1926-1927

Country	No. of shipments	No. of cases	No. of plants
France	10	169	2,090,900
Holland	14	141	1,048,515
England	7	11	90,500
	31	321	3,229,915

These 31 shipments were imported by 11 different Connecticut firms, 18 shipments being consigned to two firms. Of the total number of shipments, 20 shipments contained only rose stocks,

6 shipments contained only fruit stocks, and 5 shipments contained both rose and fruit stocks.

Of this plant material inspected, 1,635,915, or about 51 per cent, were rose stocks, and 1,594,000, or about 49 per cent, were fruit seedlings. The number of each variety is shown in the following table:

KINDS OF STOCK IMPORTED

Variety	Number of Plants	Total
FRUIT STOCKS		
Apple (all kinds)	517,000	
Cherry (all kinds)	689,500	
Hazel (*Corylus avellana*)	2,000	
Pear	103,000	
Plum	232,500	
Quince	50,000	1,594,000
ROSE STOCKS		
Rosa manetti	1,206,015	
Rosa multiflora japonica	308,900	
Rosa rugosa	*12[illegible],000*	*1,635,915*
Total		3,229,915

The following table shows the quantities of stock inspected, by months:

Month	No. of shipments	No. of cases	No. of plants
December	5	12	79,500
January	19	277	2,831,915
February	4	26	218,500
March	3	6	100,000
	31	321	3,229,915

The time required to inspect this stock is equivalent to one man working 47 days, and this time, together with the cost of travel and other necessary expenses, amounts to about $500.

In addition to the material enumerated and tabulated on the foregoing pages there were 27 shipments of tree seeds which were not inspected in Connecticut. Regarding all shipments of imported stock, 51 reports were made to the Federal Horticultural Board.

Of the 31 shipments inspected, 22 shipments, or about 70 per cent, were found infested with insects or plant diseases, some of which are well-known pests. Details regarding these infestations are given below.

PESTS FOUND ON IMPORTED NURSERY STOCK

22 Shipments Infested

INSECTS

Acronycta rumicis Linn., on cherry (1 shipment). Andre Choplin, Maze. France.

Agrilus viridis var. *fagi* Ratz., work of, on Manetti (1 shipment). Felix & Dykhuis, Holland.

Aporia crataegi Linn., nests on apple (1 shipment). Andre Chopin, Maze, France.
Calophasia lunula Hubn. (3 shipments) on quince. A. Fermaud, Angers, France. On apple, pear and plum, Andre Choplin, Maze, France.
Emphytus cinctus Linn. (14 shipments). A Fermaud, Angers, France; Hemeray Aubert, Orleans, France; Oudyk Bros. Nurseries, Boskoop, Holland; C. Klijn & Co., Boskoop, Holland; Chas. Walter Slocock, Woking, Surrey, England; Fa. As. Ouwerkerk, Boskoop, Holland; P. Ouwerkerk, Boskoop, Holland; Louis Leroy's Nursery, Angers, France.
Euproctis chrysorrhoea Linn., on apple (1 shipment) winter nest. Andre Choplin, Maze, France.
Hymenopterous pupae (1 shipment). A. Fermaud, Angers, France.
Lepidopterous pupae, unidentified (7 shipments). Louis Sebire & Sons, Ussy, Calvados, France; *butterfly*, *Andre Choplin, Maze, France;* Louis Leroy, Angers, France; A. Fermaud, Angers, France.
Lymantid larva on apple (1 shipment). Andre Choplin, Maze, France.
Noctuid moth on pear (1 shipment). A. Fermaud, Angers, France.
Notolophus antiqua Linn. on apple (1 shipment). Louis Sebire & Sons, Ussy, Calvados, France.
Papilio podalirius Linn. (2 shipments) cocoons on apple and cherry. Andre Choplin, Maze, France.
Sitona sp. weevil in spider's web (1 shipment). A. Fermaud, Angers, France.
Spider's eggs (3 shipments) on cherry. Andre Choplin, Maze, France; on quince, Louis Leroy's Nursery, Angers, France.
Vanessa sp. on rose (1 shipment). A. Fermaud, Angers, France.
Woolly aphid *on apple (2 shipments).* Louis Sebire & Sons, Ussy, Calvados, France; on rose, Oudyk Bros., Boskoop, Holland.

Plant Diseases

Crown gall on rose (2 shipments). Walter C. Slocock, Woking, Surrey, England; R. H. Bath, Ltd., Wisbeck, England.

INSPECTION OF APIARIES IN 1927

In 1927, as for several years past, the apiaries have been inspected by Messrs. H. W. Coley of Westport and A. W. Yates of Hartford, on a *per diem* basis. Mr. Coley covers the southern half of the State (Fairfield, New Haven, Middlesex, and New London Counties), and Mr. Yates the northern half (Litchfield, Hartford, Tolland, and Windham Counties).

This work in 1927 required 136 man days and with traveling expenses cost $1,905. In all, 803 apiaries, containing 8,133 colonies, were inspected in 1927, as against 814 apiaries, containing 7,923 colonies, in 1926. The apiaries averaged 10.1 colonies each in 1927, and 9.7 each in 1926.

The following table shows the number of apiaries and colonies inspected and the average number of colonies per apiary, as well as the cost per apiary and colony for each year since the inspection work was commenced in 1910:

EIGHTEEN-YEAR RECORD OF APIARY INSPECTION IN CONNECTICUT

Year	No. of Apiaries	No. of Colonies	Average No. Colonies Per Apiary	Average Cost of Inspection Per Apiary	Average Cost of Inspection Per Colony
1910	208	1,595	7.6	$2.40	.28
1911	162	1,571	9.7	1.99	.21
1912	153	1,431	9.3	1.96	.21
1913	189	1,500	7.9	1.63	.21
1914	463	3,882	8.38	1.62	.19
1915	494	4,241	8.58	1.51	.175
1916	467	3,898	8.34	1.61	.19
1917	473	4,506	9.52	1.58	.166
1918	395	3,047	7.8	1.97	.25
1919	723	6,070	11.2	2.45	.29
1920	762	4,797	6.5	2.565	.41
1921	751	6,972	9.2	2.638	.24
1922	797	8,007	10.04	2.60	.257
1923	725	6,802	9.38	2.55	.27
1924	953	8,929	9.4	2.42	.25
1925	766	8,257	10.7	2.45	.22
1926	814	7,923	9.7	2.35	.24
1927	803	8,133	10.1	2.37	.234

In 1927, apiaries were inspected in 135 towns, as against 137 towns in 1926, and 118 towns in 1925.

Inspections were made in the following 17 towns in 1927, which were not visited in 1926: Fairfield County—Monroe, Shelton, Stratford, and Trumbull; New Haven County—Ansonia, Milford, Oxford, Seymour, West Haven; Middlesex County—Essex; New London County—New London; Litchfield County—Plymouth; Hartford County—Marlborough, Windsor Locks; Tolland County—Hebron; Windham County—Chaplin, Thompson.

On the other hand, the following 19 towns, where inspections were made in 1926, were not visited by the inspectors in 1927: Fairfield County—Norwalk; New Haven County—Branford, East Haven, Meriden, Middlebury, North Branford, Orange; Middlesex County—Killingworth; New London County—East Lyme, Lyme, Old Lyme, Preston, Sprague; Litchfield County—Cornwall, Goshen; Hartford County—Enfield, Southington; Windham County—Pomfret, Sterling.

There are several towns where no recent inspections have been made. In Southbury (New Haven County) the last inspection was made in 1916. In Warren (Litchfield County) no apiaries have been inspected since 1919, though the inspector has made inquiries and failed to learn of any beekeepers in the town. In New Fairfield and Sherman (Fairfield County) the last inspections were made in 1920, and Bethany (New Haven County) and Bridgeport (Fairfield County) have not been inspected since 1922. Inspections have not been made since 1924 in Hamden, New Haven and Wolcott (New Haven County), Weston (Fairfield County), and Eastford (Windham County). In 1925 the last inspections

were made in Cheshire (New Haven County), Saybrook (Middlesex County), and South Windsor (Hartford County).

European Foul Brood

This is a disease of the young larvae, caused by a bacterial germ known as *Bacillus pluton,* and commonly called European foul brood. Usually it is more troublesome in early summer than at other times during the year, the cell contents are not ropy or gelatinous, and though often with the odor of fermentation, it is not very offensive. Requeening with Italian queens and uniting two or more weak colonies to make them strong are common methods of control.

Of the 803 apiaries and 8,133 colonies inspected in 1927, 9 apiaries and 23 colonies were found infested with European foul brood. This infestation amounts to 1.12 per cent of the apiaries and .282 per cent of the whole number of colonies inspected during the season—the lowest percentages ever found in Connecticut since the beginning of the inspection work.

The following table gives a complete record of percentages of infestation of European foul brood in Connecticut since the inspection work began in 1910:

RECORD OF EUROPEAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Colonies	Year	Percentage of Infestation Apiaries	Colonies
1910	75.9	49.7	1919	6.6	1.2
1911	51.8	27.4	1920	4.3	1.5
1912	47.7	23.5	1921	3.91	1.26
1913	44.4	24.5	1922	4.14	.85
1914	32.6	13.9	1923	2.34	.36
1915	26.1	10.3	1924	1.78	.526
1916	18.8	7.05	1925	2.48	.507
1917	16.7	4.86	1926	3.19	.858
1918	9.8	3.3	1927	1.12	.282

During 1927, European foul brood was discovered only in the following seven towns: Plymouth in Litchfield County; Bristol, Farmington, Granby, Plainville, and Windsor Locks in Hartford County; and Stafford in Tolland County. No apiaries infested with this disease were found in Fairfield, New Haven, Middlesex, New London, or Windham Counties.

American Foul Brood

American foul brood is also a disease of the larvae caused by the bacterial organism known to science as *Bacillus larvae,* but it attacks the brood at a later stage of development than does the European foul brood. It usually shows when the larvae are nearly mature or pupating after the cells are sealed. The diseased cells are shrunken, and if broken open, the contents have a peculiar

ropy or stringy consistency and give off a very offensive odor. Formerly the treatment was to shake the bees into clean hives, destroy the infected combs, and disinfect the old hives. Now the diseased combs may be sterilized by soaking them in an alcohol-formalin solution containing twenty per cent of formalin, after which they may be used with safety.

Of the 803 apiaries and 8,133 colonies inspected in 1927, 25 apiaries and 57 colonies were infested with American foul brood. This infestation is equivalent to 3.11 per cent of the apiaries and .7 per cent of the colonies inspected in 1927. This record for 1927 is a greater percentage of infested apiaries than is usually found and was exceeded only in 1925; it is the highest percentage of colonies ever found infested with this disease.

The following table shows a complete record regarding American foul brood since apiary inspection was started in Connecticut in 1910:

RECORD OF AMERICAN FOUL BROOD

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies	Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	0	0	1919	3	1.1
1911	0	0	1920	1.18	.25
1912	0	0	1921	2.5	.56
1913	0	0	1922	1.38	.27
1914	1.07	.7	1923	.985	.323
1915	.8	.18	1924	1.04	.22
1916	1.07	.15	1925	3.26	.424
1917	.42	.17	1926	1.72	.29
1918	1.01	.32	1927	3.11	.70

During 1927, American foul brood was found in the following 16 towns: Derby, Madison, Naugatuck, Prospect, and Wallingford, in New Haven County; Durham in Middlesex County; Norwich in New London County; Bethlehem, Litchfield, North Canaan, Plymouth, Torrington, Washington, and Winchester, in Litchfield County; Bristol in Hartford County; and Ellington in Tolland County.

Sacbrood

Sacbrood or pickled brood is a disease often mistaken for American or European foul brood. The cause is considered to be a filterable virus. The larvae die about the time the cells are capped and lie on their backs with heads turned upward. The body is swollen and contents watery, but there is no ropiness, and the entire cell contents may easily be removed intact as if enclosed in a sac. The color is variable, though often light yellow or brown, with head nearly black. The usual treatment is to make strong colonies by uniting the weak ones. In certain rare cases where whole apiaries become infected, new queens should be supplied to all the colonies.

The following table shows the record of sacbrood since apiary inspection in Connecticut started in 1910:

RECORD OF SACBROOD

Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies	Year	Percentage of Infestation Apiaries	Percentage of Infestation Colonies
1910	0	0	1919	1.24	.19
1911	..	.51	1920	1.18	.229
1912	..	Several	1921	1.06	.157
1913	..	2.8	1922	1.37	.187
1914	2.59	.721	1923	.53	.086
1915	2.02	.47	1924	1.78	.52
1916	.428	.051	1925	3.39	.836
1917	1.48	.199	1926	1.1	.138
1918	.253	.032	1927	.03	.0036

During the year, sacbrood was found in the following three towns: Essex and Portland in Middlesex County, and Voluntown in New London County.

Statistics of Inspection

The statistics of apiary inspection by towns and counties may be found in the following pages, with summary on page 230.

INSPECTION OF APIARIES, 1927

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Fairfield County:							
Bethel	4	0	37	0	0	0	0
Brookfield	3	0	68	0	0	0	0
Danbury	12	0	146	0	0	0	0
Darien	1	0	42	0	0	0	0
Easton	3	0	87	0	0	0	0
Fairfield	7	0	93	0	0	0	0
Greenwich	21	0	220	0	0	0	0
Monroe	6	0	89	0	0	0	0
New Canaan	3	0	25	0	0	0	0
Norwalk	2	0	41	0	0	0	0
Redding	3	0	51	0	0	0	0
Ridgefield	5	0	48	0	0	0	0
Shelton	2	0	27	0	0	0	0
Stamford	8	0	161	0	0	0	0
Stratford	1	0	28	0	0	0	0
Trumbull	2	0	32	0	0	0	0
Westport	2	0	18	0	0	0	0
Wilton	9	0	179	0	0	0	0
	94	0	1392	0	0	0	0
New Haven County:							
Ansonia	7	0	41	0	0	0	0
Beacon Falls	2	0	48	0	0	0	0
Derby	3	1	21	1	1	0	0
Guilford	4	0	37	0	0	0	0
Madison	3*	2	18	4	4	0	0
Milford	5	0	48	0	0	0	0

* One apiary inspected three times.

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
New Haven County—*Continued*							
Naugatuck....	6	2	64	2	2	0	0
North Haven..	2	0	31	0	0	0	0
Oxford........	2	0	38	0	0	0	0
Prospect......	5	1	39	4	4	0	0
Seymour......	3	0	13	0	0	0	0
Wallingford....	17**	4	107	7	7	0	0
Waterbury....	6	0	42	0	0	0	0
West Haven...	1	0	8	0	0	0	0
	66	10	555	18	18	0	0

** Two apiaries inspected twice.

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Middlesex County:							
Chester.......	5	0	45	0	0	0	0
Clinton.......	4	0	59	0	0	0	0
Cromwell......	6	0	59	0	0	0	0
Durham.......	7	1	163	1	1	0	0
East Haddam..	5	0	178	0	0	0	0
East Hampton.	13	0	218	0	0	0	0
Essex.........	5	1	50	1	0	0	1
Haddam......	5	0	58	0	0	0	0
Middlefield....	2	0	53	0	0	0	0
Middletown....	5	0	77	0	0	0	0
Old Saybrook..	5	0	74	0	0	0	0
Portland......	6	1	61	1	0	0	1
Westbrook.....	1	0	8	0	0	0	0
	69	3	1103	3	1	0	2
New London County:							
Bozrah........	1	0	15	0	0	0	0
Colchester.....	6	0	54	0	0	0	0
Franklin......	2	0	77	0	0	0	0
Griswold......	3	0	94	0	0	0	0
Groton........	1	0	32	0	0	0	0
Lebanon......	6	0	116	0	0	0	0
Ledyard.......	3	0	40	0	0	0	0
Lisbon........	2	0	28	0	0	0	0
Montville.....	6	0	60	0	0	0	0
New London...	3	0	15	0	0	0	0
No. Stonington	3	0	35	0	0	0	0
Norwich......	10	2	248	6	6	0	0
Salem.........	1	0	8	0	0	0	0
Stonington....	9	0	68	0	0	0	0
Voluntown.....	4	1	31	1	0	0	1
Waterford.....	3	0	52	0	0	0	0
	63	3	973	7	6	0	1
LitchfieldCounty:							
Barkhamsted...	2	0	4	0	0	0	0
Bethlehem.....	10	2	45	7	7	0	0
Bridgewater...	6	0	94	0	0	0	0
Canaan.......	2	0	4	0	0	0	0
Colebrook.....	2	0	28	0	0	0	0
Harwinton.....	7	0	22	0	0	0	0
Kent..........	4	0	85	0	0	0	0
Litchfield......	4	1	55	1	1	0	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Litchfield County—*Continued*							
Morris	4	0	24	0	0	0	0
New Hartford	4	0	11	0	0	0	0
New Milford	6	0	46	0	0	0	0
Norfolk	5	0	25	0	0	0	0
North Canaan	8	1	79	1	1	0	0
Plymouth	9*	5	53	13	4	9	0
Roxbury	4	0	29	0	0	0	0
Salisbury	8	0	64	0	0	0	0
Sharon	4	0	118	0	0	0	0
Thomaston	11	0	60	0	0	0	0
Torrington	9	1	78	2	2	0	0
Washington	6	1	122	5	5	0	0
Watertown	9	0	56	0	0	0	0
Winchester	12	1	66	3	3	0	0
Woodbury	3	0	69	0	0	0	0
	139	12	1237	32	23	9	0

*1 colony inspected twice.

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Hartford County:							
Avon	3	0	22	0	0	0	0
Berlin	12	0	159	0	0	0	0
Bloomfield	5	0	147	0	0	0	0
Bristol	13	2	62	5	1	4	0
Burlington	6	0	20	0	0	0	0
Canton	6	0	34	0	0	0	0
East Granby	2	0	20	0	0	0	0
East Hartford	3	0	29	0	0	0	0
East Windsor	13	0	58	0	0	0	0
Farmington	13	1	59	3	0	3	0
Glastonbury	14	0	151	0	0	0	0
Granby	10	1	78	3	0	3	0
Hartford	4	0	11	0	0	0	0
Hartland	1	0	60	0	0	0	0
Manchester	7	0	67	0	0	0	0
Marlborough	2	0	35	0	0	0	0
New Britain	11	1*	90	1*	0	0	0
Newington	7	0	53	0	0	0	0
Plainville	8	1	29	1	0	1	0
Rocky Hill	3	0	33	0	0	0	0
Simsbury	10	0	75	0	0	0	0
Suffield	10	0	86	0	0	0	0
West Hartford	8	0	77	0	0	0	0
Wethersfield	10	0	49	0	0	0	0
Windsor	11	0	84	0	0	0	0
Windsor Locks	6	1	24	1	0	1	0
	198	7	1612	14	1	12	0

*Bee paralysis

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Tolland County:							
Andover	3	0	21	0	0	0	0
Bolton	3	0	14	0	0	0	0
Columbia	5	0	14	0	0	0	0
Coventry	13	0	126	0	0	0	0
Ellington	14	2	75	8	8	0	0
Hebron	5	0	23	0	0	0	0
Mansfield	16	0	79	0	0	0	0

Town	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Tolland County—*Continued*							
Somers........	1	0	1	0	0	0	0
Stafford.......	8	1	28	2	0	2	0
Tolland.......	6	0	42	0	0	0	0
Union.........	1	0	5	0	0	0	0
Vernon........	7	0	49	0	0	0	0
Willington.....	8	0	34	0	0	0	0
	90	3	511	10	8	2	0
Windham County:							
Ashford.......	3	0	38	0	0	0	0
Brooklyn......	4	0	167	0	0	0	0
Canterbury....	4	0	27	0	0	0	0
Chaplin.......	3	0	28	0	0	0	0
Hampton......	11	0	94	0	0	0	0
Killingly......	16	0	76	0	0	0	0
Plainfield......	18	0	80	0	0	0	0
Putnam.......	4	0	26	0	0	0	0
Scotland.......	4	0	36	0	0	0	0
Thompson.....	7	0	58	0	0	0	0
Windham......	7	0	80	0	0	0	0
Woodstock....	3	0	40	0	0	0	0
	84	0	750	0	0	0	0

SUMMARY

County	No. Towns	Apiaries Inspected	Apiaries Diseased	Colonies Inspected	Colonies Diseased	Foul Brood American	Foul Brood European	Sacbrood
Fairfield....	18	94	0	1,392	0	0	0	0
New Haven.	14	66	10	555	18	18	0	0
Middlesex..	13	69	3	1,103	3	1	0	2
New London	16	63	3	973	7	6	0	.1
Litchfield...	23	139	12	1,237	32	23	9	0
Hartford...	26	198	7*	1,612	14*	1	12	0
Tolland....	13	90	3	511	10	8	2	0
Windham..	12	84	0	750	0	0	0	0
	135	803	38	8133	84	57	23	3

*1 colony had bee paralysis.

	No. Apiaries	No. Colonies
Inspected............................	803	8133
Infested with European foul brood......	9	23
Per cent infested.....................	1.12	.282
Infested with American foul brood......	25	57
Per cent infested.....................	3.113	.7
Infested with sacbrood................	3	3
Infested with bee paralysis.............	1	1
Average number of colonies per apiary..		10.1
Cost of inspection.....................		$1905.
Average cost per apiary...............		2.37
Average cost per colony...............		.234

GIPSY MOTH WORK IN CONNECTICUT, 1927

JOHN T. ASHWORTH AND W. E. BRITTON

This work is conducted in close co-operation with the Federal Bureau of Entomology, and all State and Federal men in charge of the work realize that more and better results can be obtained in this manner. We wish here to express our thanks and appreciation to Messrs. A. F. Burgess, C. W. Collins, and H. L. Blaisdell of the Federal Bureau for their assistance and co-operation.

In the following report of the work done in the separate towns, no mention has been made of the areas sprayed, but by turning to the table of statistics one can easily estimate the amount of spraying done, as seventy-five pounds of arsenate of lead will spray about one acre of the average woodland.

FINANCIAL STATEMENT

RECEIPTS

Appropriation for biennial period ending June 30, 1927		$100,000.00	
Expended July 1, 1925 to June 30, 1926		53,125.56	
Balance available July 1, 1926			46,874.44
Additional appropriation, General Assembly of 1927			10,000.00
Total			$56,874.44

EXPENDITURES

Salaries		4,747.50	
Labor		42,018.06	
Stationery and office supplies		56.40	
Sundry supplies		3.85	
Communication service			
Telegraph	.35		
Telephone	95.65		
Postage	2.63	98.63	
Travel expenses 512.29; Gasoline 2,566.19		3,078.48	
Transportation of things; express		2.76	
Publications; Printing legal notices in papers		42.00	
Heat, light, water and power			
Fuel—coal	181.00		
Light—electricity	14.64	195.54	
Live stock poisoned by lead arsenate		245.00	
Tools, machinery and appliances		5,013.02	
Buildings and land			
Office rental	24.00		
Garage rental	626.55	650.55	
Contingent expenses			
Insurance—motor vehicles	682.20		
Medical services	38.00		
Registration	1.00	721.20	
			$56,873.09
Balance			1.35
			$56,874.44

Details of Work by Counties and Towns

The following pages contain a detailed account of the scouting, spraying, and other control measures in the infested towns. All egg-clusters found were treated with creosote to prevent hatching. The statistics are given in the tables beginning on page 241, and are summarized on page 243.

WINDHAM COUNTY

The only scouting done in Windham County this year was in the towns of Brooklyn, Canterbury, Killingly, and Putnam, where both State and Federal men were trained during the fall and early winter, then transferred to other parts of the territory. Federal men scouted in Brooklyn, Killingly, and Putnam, and State men in Canterbury.

Brooklyn—4 Infestations—93 Egg-clusters

The largest colony found in the town was one of 35 egg-clusters on oak trees in the southeastern corner of the town near the Quinebaug River. Another one, of 30 egg-clusters, was on oak and birch growth owned by Mike Caffery, situated in the north-central portion of the town near the Pomfret town line. Two of these colonies were sprayed by State men in June.

Canterbury—18 Infestations—1,565 Egg-clusters

Canterbury was scouted by green men training for State crews, and only the northern half of the town was completed. Three large colonies were found, the largest being in the northeastern corner of the town on land owned by Andrew Clark, where 1,035 egg-clusters occurred on ten trees in a pasture. The next largest was about one mile west of the colony just mentioned, on two apple trees in a pasture, owned by Mrs. Ida Shorter, and containing 115 egg-clusters. The third colony contained 83 egg-clusters and was located about one and one-half miles west of the colony last mentioned, in woodland owned by Mr. Beauchene. Nine places were sprayed in the spring by a State crew.

Killingly—18 Infestations—993 Egg-clusters

Killingly is still generally infested, though only four large colonies were found this year; one, of 300 egg-clusters, was in the northwestern corner of the town in apple and oak trees on land owned by R. Butler; about a mile south of this colony another, of 85 egg-clusters, was found in mixed growth, and there were two other colonies in this same section of the town (known as the "Chestnut Hill section"); one of 75 egg-clusters on oak trees owned by B. A. Larkin, and one of 55 egg-clusters on apple trees

on an adjoining farm owned by Ervin Hill. Thirteen of the 18 colonies were sprayed by State men.

Putnam—17 Infestations—413 Egg-clusters

Three large colonies were found in Putnam this year, and although the town is generally infested, all the infestations discovered were under twenty egg-clusters each, except the three mentioned here. The largest contained 130 egg-clusters in oak trees and stone wall on woodland margin near the town line, on the east side of the State road leading to Mechanicsville. Another colony of 75 egg-clusters was in an orchard owned by Jerome Shippee, in the southwestern part of the town. The third contained 50 egg-clusters on oaks in East Putnam just south of the Four Corners. Fifteen of the seventeen colonies were sprayed in the spring by State men.

NEW LONDON COUNTY

Colchester—3 Infestations—585 Egg-clusters

The old colony on Edwin Brown's property was again found infested, and 496 egg-clusters were creosoted there. Another colony of 77 egg-clusters was found in woodland owned by Levine Himen, and a third colony containing 12 egg-clusters in woodland owned by Steve Fedus. All three infestations were situated in the eastern half of the town. A large amount of spraying was done by State men in this town, where extreme measures were taken to eradicate these colonies. Over a ton of dry arsenate of lead was used and about 45 acres of woodland were sprayed.

Groton—16 Infestations—389 Egg-clusters

Groton was scouted in the late spring, and before the town was completed the men were called in to start spraying. One colony of 87 egg-clusters was found on 14 trees, stone wall and fence situated along the State road leading from Mystic to Groton, just west of Mystic village: another of 79 egg-clusters on land owned by Spicer Coal Company in Groton village; 50 egg-clusters were found on cherry trees, fence, stone wall and shed owned by C. C. Todd, near the Sea Sled plant, and one of 47 egg-clusters was found on 17 trees located on the Sea Sled property. These were the largest colonies found this year in Groton, and 12 of the 16 infestations were sprayed by State men.

Stonington—9 Infestations—5,572 Egg-clusters

In scouting Stonington this year several large colonies were discovered. In Stonington village 1,159 egg-clusters were found on 174 trees scattered all through the village. Another colony of 4,004 egg-clusters was found in oak, hickory, and birch on land

owned by Silas Wheeler and Mrs. Boynton, just north of the village of Old Mystic. The scouting on "Mason's Island" was not completed, as the men had to be called in to start spraying. However, 215 egg-clusters were found in this district up to the time scouting was discontinued. Practically all trees and shrubs in the village of Stonington were sprayed, and on Mason's Island a large proportion of the native tree growth was sprayed. The nine infestations were sprayed by State men.

We wish to take this opportunity to thank the town officials and citizens for their co-operation and help in this fight against the gipsy moth.

TOLLAND COUNTY

Andover

Andover was scouted by State men during March, but no trace of the gipsy moth was found.

Bolton—2 Infestations—168 Egg-clusters

Of the 168 egg-clusters found in Bolton this year, 167 of them were in woodland owned by Mr. Alvord, about one mile southeast of Bolton village; the other infestation was in the section of the town known as "Bolton Notch," where one old egg-cluster was found on a roadside black oak. About nine acres were sprayed at the woodland colony in June by State men.

Columbia—1 Infestation—127 Egg-clusters

The scouting season was nearly over and larvae were feeding before this town could be scouted, so the work was confined to the territory around last year's infestation. A crew was sent to put in one day around this colony, and finding larvae feeding, no scouting was done, but later in the spring, on June 17, State men sprayed about three acres of woodland and one orchard at this colony, which is situated on the State road leading from Columbia to Hebron, on land owned by Mr. Kretsowitz.

HARTFORD COUNTY

Burlington—4 Infestations—146 Egg-clusters

Three small infestations were discovered by a State crew in Burlington, and one large colony containing 134 egg-clusters was found in apple, oak, and maple trees on land owned by Harry Ney, located in the western part of the town near the Harwinton line. The three small infestations were close together in the northwestern corner of the town on land owned by Stephen Shuster and Ernest Ventries. Altogether, 12 egg-clusters were found at the three places. Federal men sprayed about four acres of woodland at two of these infestations.

Canton—4 Infestations—825 Egg-clusters

All four infestations found by State men in Canton this year were in the extreme northern part of the town and were all in woodland. Two of them were very large for this part of the State, the largest being on land owned by W. Fretay; 551 egg-clusters were found and creosoted on 127 trees. At Mr. L. King's place, 176 egg-clusters were treated. The two other colonies were small ones. Federal men sprayed two of these infestations.

East Granby—3 Infestations—142 Egg-clusters

A colony of two egg-clusters was found on willow trees owned by Mr. Viets, just north of East Granby post office; two larger colonies were found in the northwestern part of the town—one of 15 egg-clusters on oak and birch trees at Newgate Prison, and the other in woodland owned jointly by Messrs. Colton, Case and Clark, where 125 egg-clusters were creosoted. At the last two colonies over 30 acres of woodland were sprayed by Federal men.

East Hartford—1 Infestation—19 Egg-clusters

State men scouted East Hartford this year, but only one small colony was found. This was one of 19 egg-clusters, a reinfestation of last year's colony in woodland owned by Mr. H. E. Kenney. About four acres of woodland were sprayed on June 17 by State men.

Farmington—3 Infestations—13 Egg-clusters

The scouting in Farmington this year was confined to the territory in the northeastern part of the town—the only district that has been found infested since 1924. Three small infestations were discovered, all within an area of one square mile. One colony of five egg-clusters was in an orchard owned by Mr. F. H. Andrews, and the other two were in woodland owned by Mr. Frederick Beach, where three and five egg-clusters respectively were found. Five acres of woodland were sprayed by Federal men.

Glastonbury—6 Infestations—394 Egg-clusters

A group of four infestations was discovered in the eastern end of the town, three of them on land owned by John Sarini. One was large, containing 182 egg-clusters; the other three colonies (one on land owned by C. Zold) were all small. The two other colonies were in the western part of the town, one of 17 egg-clusters in South Glastonbury on land owned by J. B. Abendroth, and the other in Glastonbury village, in an orchard owned by A. E. Hollister, where 179 egg-clusters were found. Five of these infestations were sprayed by State men.

Granby—31 Infestations—2,873 Egg-clusters

Several large colonies were found in Granby this year by State men, four of them being the largest found in this part of the State. They were all situated in the southwestern corner of the town. The largest was one of 1,189 egg-clusters found on land owned by Messrs. Bors, Shinder and Luprun. This colony was spread over several acres of pasture and woodland. Another colony of 495 egg-clusters was found in woodland owned by A. Luprun, and one of 257 egg-clusters in woodland belonging to Willis Edgerton. The next largest colony was one of 162 egg-clusters found in woodland of Andrew Bors and A. Luprun. Six of the colonies were sprayed by Federal men.

Hartford—2 Infestations—48 Egg-clusters

Two small colonies were found in Hartford this year; one of 45 egg-clusters on three apple trees owned by Max Case, at 915 Windsor Avenue, and the other, a small colony of three egg-clusters found on two plum trees on property of D. Ahern on Crown Street. The colony on Windsor Avenue was sprayed by Federal men. It was thought unnecessary to spray around the Crown Street infestation.

Hartland—14 Infestations—343 Egg-clusters

The largest colony in the town was the only one found in the western part, and contained 78 egg-clusters in woodland owned by T. A. Howell, in the extreme northwestern corner of the town. The other 13 colonies were along the eastern border: three of them were large enough to mention here. One of 55 egg-clusters was found in woodland owned by Semon Brown, about one mile east of East Hartland post office; another of 47 egg-clusters was in woodland owned by John Liskey, about two miles north of the post office, and the third, of 46 egg-clusters, was in woodland belonging to Lawrence Ransom just west of the post office. Eight of the places were sprayed by Federal men.

New Britain—4 Infestations—106 Egg-clusters

Although the foreman of the crew that scouted New Britain reported four infestations, he might have counted them as two, since three of the colonies were very close together on land owned by the Polish Orphanage and Peter and George Sieving, on or near Osgood Avenue and North Burritt Street. Altogether, 88 egg-clusters were found at these three colonies. The other colony was one of 18 egg-clusters found on five oak and hickory trees in a yard at 49 Bassett Street, owned by William Mangan. Both of the places were sprayed by Federal men.

Simsbury—12 Infestations—747 Egg-clusters

Only one important colony was found in Simsbury; this was on walnut, oak, and pine trees on land where W. W. Sperry is caretaker, a little north of the West Simsbury post office. The other colonies were all small, but since all but one were located in the western half of the town on high ground, windspread might occur under certain conditions and the young larvae might be distributed over a large area of uninfested territory. Four of the places were sprayed by Federal men.

South Windsor—1 Infestation—2 Egg-clusters

In scouting South Windsor this year, State men found only one small colony of two egg-clusters on apple and cherry trees in the yard of Mrs. Louis Sperry, in East Windsor Hill village. Spraying was thought to be unnecessary as the egg-clusters were not broken when they were found and creosoted.

Suffield—7 Infestations—292 Egg-clusters

Of the 292 egg-clusters found in Suffield, 253 were at two places; the other five colonies were small and not dangerous. At one of the large colonies, 167 egg-clusters were on five white oaks in a field owned by Henry Sheldon, about one and one-half miles north of West Suffield four corners; the other colony was one of 86 egg-clusters on the west side of the railroad near the East Granby town line, on land belonging to Frank Hastings and Andrew Barr. Three of the places were sprayed by Federal men.

West Hartford—1 Infestation—14 Egg-clusters

A very peculiar situation was found by State men while scouting West Hartford this year: The only colony was one of 14 old egg-clusters; no new ones could be found. This colony is being watched to find out the reason why there were no new egg-clusters. This colony was near the western border of the town on the water reservation of the city of Hartford. No spraying was done at this place.

MIDDLESEX COUNTY

Two towns in this county were scouted by State men, but only one colony was found, this being in Middletown, nearly in the center of the township, on land of C. S. Wadsworth, where 49 egg-clusters were found on trees and in a stone wall. Five acres of woodland were sprayed by Federal men.

The other town scouted was Haddam, but no trace of the gipsy moth was found.

NEW HAVEN COUNTY

Federal men did all the spraying and scouting in all the towns of this county except Meriden and Wolcott, where State men did the scouting.

Meriden—3 Infestations—48 Egg-clusters

A group of three colonies was discovered by a State crew in Meriden near the center of the town. One of 31 egg-clusters was on shade trees, a fence, and stone wall at 60 Pratt Street, owned by George King. Another, of 13 egg-clusters, was on apple and cherry trees belonging to E. W. Pulley of 154 Miller Street, and the third was a small colony of four egg-clusters on maple trees at 107 East Main Street, owned by E. M. Curtis. Spraying was done at all three places in the spring.

New Haven—1 Infestation—8 Egg-clusters

Federal men scouted New Haven and found one small colony of 8 egg-clusters on land of K. O. Carlson at 45 Sheldon Terrace. Ten apple trees and 150 shade trees, covering parts of several city blocks, were sprayed in and around this colony.

Seymour—1 Infestation—121 Egg-clusters

One large isolated colony was discovered by Federal men while they were scouting this town. Altogether, 121 egg-clusters were found in woodland of the Birmingham Water Company situated on the western border of the town, on the line between Seymour and Oxford. This being an isolated colony and far west of the general infestation, eradication instead of control methods was practiced. All deadwood, both standing and on the ground, together with other refuse, was cleaned up and burned. In the spring before the eggs hatched, all the trees were banded with tree tanglefoot; later, when the foliage was out, the trees in and around this colony were sprayed.

Wolcott—1 Infestation—4 Egg-clusters

State men scouted part of this town, covering about 20 miles of roadside. It was not thought necessary to scout the whole town as no infestation had ever been found except in one small spot. Four egg-clusters were found in a woodland owned by Bessie Wilson, located about three-quarters of a mile north of Wolcott post office; 997 egg-clusters were found at this same place last year. About two acres of woodland were sprayed by Federal men in the spring.

Woodbridge—1 Infestation—499 Egg-clusters

A large colony was found in Woodbridge, containing 499 egg-clusters, on oak, birch and maple trees, and bayberry bushes, in a pasture belonging to S. J. Peck, about one mile south of Woodbridge village. The same methods were used at this colony as at the one in Seymour; namely, cleaning, burning, banding with tanglefoot, and spraying. This work was all done by Federal men.

Nine other towns in New Haven County were scouted by Federal crews: Ansonia, Beacon Falls, Cheshire, Derby, Hamden, Milford, Oxford, Southbury, and Wallingford. but no trace of the gipsy moth was found in any of these towns.

FAIRFIELD COUNTY

All work in Fairfield County this year was done by Federal men. Fifteen towns were scouted, but no trace of the gipsy moth was found. In the Report of this Station for 1926, page 212, mention was made of a large colony in Greenwich containing 328 egg-clusters. The work done there last year brought very satisfactory results, as no trace of the pest was found this year, although very close scouting was done around the old infestation.

The other towns scouted were: Bethel, Bridgeport, Danbury, Easton, Fairfield, Monroe, Newtown, New Fairfield, Redding, Shelton, Stratford, Trumbull, Weston, and Westport.

LITCHFIELD COUNTY

All spraying in this county was done by Federal men who scouted in six towns out of thirteen.

Barkhamsted—8 Infestations—714 Egg-clusters

All the infestations found by State men while scouting Barkhamsted this year were in the eastern half of the town in woodland. The largest was a colony of 545 egg-clusters on land belonging to H. Burdick, located about a mile south of Barkhamsted post office; another, of 55 egg-clusters, was found on land owned by M. Marek, about half a mile farther south. These were the largest and most dangerous. Five of the places were sprayed.

Colebrook—3 Infestations—20 Egg-clusters

Eighteen of the 20 egg-clusters found in Colebrook by State men this year were in one colony situated in the North Colebrook section of the town in woodland owned by Carrington Phelps. The other two were single egg-cluster infestations. About three acres of woodland were sprayed.

Cornwall—1 Infestation—65 Egg-clusters

Federal men found one colony of 65 egg-clusters in Cornwall in the section known as "Swift Bridge," on land of the Dark Entry Forest. About 26 acres of woodland were sprayed.

Harwinton—1 Infestation—10 Egg-clusters

State men discovered one colony of ten egg-clusters in Harwinton, just north of the Campville post office, in woodland owned by Charles Delay. Four acres of woodland were sprayed around this colony.

New Hartford—1 Infestation—26 Egg-clusters

One colony of 26 egg-clusters was found by State men near Bakersville post office in a pasture. The owner's name could not be learned. This colony was so far back from any road that it could not be reached by the spray outfit, so men were sent a number of times during the larval season to scout the trees and kill the caterpillars by hand; 110 larvae were killed in this manner.

Norfolk—1 Infestation—9 Egg-clusters

Federal men found one small colony of one new egg-cluster and eight old ones in woodland owned by E. H. Peasley, in the northeast corner of the town. Spraying was thought unnecessary.

North Canaan—1 Infestation—32 Egg-clusters

One colony of 32 egg-clusters was found in North Canaan this year in woodland owned by James Rosier, on the eastern border of the town, and 47 acres of woodland were sprayed. All work was done by Federal men.

Plymouth—1 Infestation—6 Egg-clusters

A State crew scouted Plymouth and found one small colony of six egg-clusters on a white oak tree on land owned by Mrs. Tolles, in the southeastern corner of the town near the Wolcott line. Three-quarters of an acre of woodland was sprayed around this infestation.

Salisbury—1 Infestation—283 Egg-clusters

The colony found by Federal men while scouting Salisbury was in woodland about one mile west of Amesville village, where 283 egg-clusters were scattered over a large territory on top of the ridge. About 29 acres of woodland were sprayed to control this infestation.

Winchester—1 Infestation—15 Egg-clusters

One colony of 15 egg-clusters was discovered by State men in Winchester about one and one-half miles north of Colebrook station, near the town line, in woodland owned by Henry Terrill and Antonio Passeni. About three acres of woodland were sprayed at this infestation.

Three other towns in Litchfield County were scouted, but no gipsy moth infestations were found in them. The Federal men scouted in Canaan and New Milford around last year's infestations. Thomaston was completely scouted by State men.

STATISTICS OF INFESTATIONS 1926–1927

Towns:	No. Infestations found	No. Egg-clusters creosoted	No. Colonies sprayed	No. lbs. Poison used	No. larvae and Pupae killed	No. Miles Roadway scouted
Windham County:						
Brooklyn . . . G	4	93	2	110	357	73
Canterbury . . .	18	1,565	9	378	769	20
Killingly . . . . G	18	993	13	282	1,058	116
Putnam . . . . . G	17	413	15	2,027	621	27
	57	3,064	39	2,797	2,805	236
New London County:						
Colchester	3	585	3	2,050	0	104
Groton	16	389	12	2,977	460	19
Stonington	9	5,572	9	2,497	1,128	11
	28	6,546	24	7,524	1,588	134
Tolland County						
Andover	0	0	0	0	0	42
Bolton	2	168	1	450	25	41
Columbia	1	127	1	150	0	3
	3	295	2	600	25	86
Hartford County:						
Bloomfield	0	0	0	0	0	84
Burlington	4	146	2	250	0	22
Canton	4	825	2	2,095	197	40
East Granby . .	3	142	2	1,625	5	33
East Hartford.	1	19	1	200	2	59
East Windsor.	0	0	0	0	0	14
Farmington . . .	3	13	1	330	101	6
Glastonbury . .	6	394	5	262	63	101
Granby	31	2,873	6	2,395	558	123
Hartford	2	48	1	87	9	106
Hartland	14	343	8	2,162	218	64
Marlboro	0	0	0	0	0	45
New Britain . .	4	106	2	600	47	18
Simsbury	12	747	4	900	221	80
South Windsor	1	2	0	0	0	78
Suffield	7	292	3	437	47	76

Towns:	No. Infestations found	No. Egg-clusters creosoted	No. Colonies sprayed	No. lbs. Poison used	No. larvae and Pupae killed	No. Miles Roadway scouted
Hartford County—*Continued*						
West Hartford	1	14	0	0	0	96
Windsor......	0	0	0	0	0	7
	93	5,964	37	11,343	1,468	1,052
Middlesex County:						
Haddam.....	0	0	0	0	0	167
Middletown ..	1	49	1	275	14	123
	1	49	1	275	14	290
New Haven County:						
Ansonia.....G	0	0	0	0	0	41
Beacon Falls G	0	0	0	0	0	21
Cheshire....G*	0	0	0	0	0	
Derby......G	0	0	0	0	0	50
Hamden....G*	0	0	0	0	0	
Meriden......	3	48	3	637	10	26
Milford.....G	0	0	0	0	0	82
New Haven.G*	1	8	1	212	0	
Oxford......G	0	0	0	0	0	79
Seymour....G	1	121	1	775	0	47
Southbury..G	0	0	0	0	0	123
Wallingford.G*	0	0	0	0	0	
Wolcott......	1	4	1	100	0	20
Woodbridge.G	1	499	1	425	0	15
	7	680	7	1,937	10	504
Litchfield County:						
Barkhamsted..	8	714	5	1,975	131	84
Canaan.....G*	0	0	0	0	0	
Colebrook....	3	20	1	175	0	65
Cornwall....G*	1	65	1	1,250	0	
Harwinton....	1	10	1	225	0	26
New Hartford	1	26	0	0	116	14
New Milford G*	0	0	0	0	0	
Norfolk.....G*	1	9	0	0	0	
North Canaan G*	1	32	0	0	0	
Plymouth....	1	6	1	50	0	13
Salisbury....G*	1	283	0	0	0	
Thomaston...	0	0	0	0	0	51
Winchester...	1	15	1	100	0	106
	19	1,179	10	3,775	247	359
Fairfield County:						
Bethel......G	0	0	0	0	0	49
Bridgeport..G	0	0	0	0	0	242
Danbury....G	0	0	0	0	0	147
Easton......G	0	0	0	0	0	80
Fairfield.....G	0	0	0	0	0	175
Greenwich..G	0	0	0	0	0	116
Monroe.....G	0	0	0	0	0	74

G, *Work done by Federal men*

* Scouting done around old infestations

Towns:	No. Infestations found	No. Egg-clusters creosoted	No. Colonies sprayed	No. lbs. Poison used	No. larvae and Pupae killed	No. Miles Roadway scouted
Fairfield County—*Continued*						
Newtown...G	0	0	0	0	0	180
New FairfieldG	0	0	0	0	0	51
Redding....G	0	0	0	0	0	97
Shelton.....G	0	0	0	0	0	92
Stratford....G	0	0	0	0	0	111
Trumbull...G	0	0	0	0	0	70
Weston.....G	0	0	0	0	0	51
Westport....G	0	0	0	0	0	84
	0	0	0	0	0	1,619

G, Work done by Federal men

SUMMARY OF STATISTICS

County	No. Towns Covered	No. Infestations found	No. Egg-clusters Creosoted	No. Colonies Sprayed	No. lbs. Poison used	No. larvae and Pupae Killed	No. Miles Roadway Scouted
Windham.....	4	57	3,064	39	2,797	2,805	236
New London..	3	28	6,546	24	7,524	1,588	134
Tolland......	3	3	295	2	600	25	86
Hartford.....	18	93	5,964	37	11,343	1,468	1,052
Middlesex....	2	1	49	1	275	14	290
New Haven...	14	7	680	7	1,937	10	504
Litchfield.....	13	19	1,179	10	3,775	247	359
Fairfield......	15	0	0	0	0	0	1,619
	72	208	17,777	120	28,251	6,157	4,280

Parasites

During the past two years the parasites introduced into this country to aid in the control of the gipsy moth have not been so abundant as in 1924, and their recoveries from egg-clusters gathered in the field have been rather meager. These parasites are brought into the United States by the Federal Bureau of Entomology, and numbers of them are reared at the Parasite Laboratory of the Bureau at Melrose Highlands, Mass. When they are ready in sufficient numbers for distribution, the supply for Connecticut is turned over to State men, who distribute them.

An account of these parasites may be found in the Report of this Station for 1922, page 314. Each succeeding year a report has been given on the number of parasites liberated within the State, and the references to these liberations are as follows: 1923, page 265; 1924, page 271; 1925, page 271; 1926, page 215.

During 1927, only one parasite was liberated in Connecticut and that a minute four-winged fly, *Anastatus bifasciatus,* which is a parasite of the gipsy moth eggs. Altogether, 596,000 of these tiny helpers were liberated in 31 towns. The names of these

towns and the number of parasites placed in each are given in the table below:

List of Towns and Number of *Anastatus* Parasites Liberated in Each Town

Town	Amount
Columbia	10,000
Colchester	30,000
Barkhamsted	32,000
Granby	42,000
Simsbury	20,000
Hartland	18,000
East Granby	17,000
Suffield	9,000
Somers	2,000
East Hartford	5,000
Glastonbury	12,000
Canterbury	55,000
Killingly	26,000
Putnam	26,000
Eastford	68,000
Stonington	15,000
North Stonington	10,000
Preston	3,000
Voluntown	3,000
Sterling	25,000
Plainfield	17,000
Griswold	5,000
Brooklyn	35,000
Bolton	11,000
Ellington	3,000
Hampton	5,000
Chaplin	8,000
Ashford	30,000
Union	9,000
Woodstock	23,000
Thompson	22,000
	596,000

Defoliation by Gipsy Caterpillars

No conspicuous defoliation or stripping of trees by gipsy moth caterpillars has ever occurred in Connecticut, though many acres of woodland areas have been successively defoliated in Massachusetts, and many trees killed. It is probable that the thorough and persistent, though intermittent system of scouting and spraying maintained by the State in the older infested portion of Connecticut has prevented any such occurrence. Several large woodland colonies have been discovered in Connecticut and eradicated—some of them ten or more years ago. Had these been allowed to continue unmolested, it is very probable that by this time the infestation would have become so intense that severe defoliation might result.

Learning of severe defoliation in Eastern Massachusetts in 1927, Commissioner Edward F. Hall and William A. Hendrick of the

State Board of Finance and Control, and Messrs. Britton and Ashworth of this Department, made a visit to the region bounded by Taunton, New Bedford, and Fall River on July 12. The party met at Hartford and drove by automobile via Willimantic, Danielson, and Providence to Taunton, where it was met by Mr. C. W. Collins of the Federal Gipsy Moth Parasite Laboratory, at Melrose Highlands, Mass. Turning southward, they made frequent stops to examine experimental plots where tests with sprays or parasites were being conducted by Federal agencies. The party lunched at New Bedford, then drove to Fall River, and ascending a fire tower in a city park, beheld a view of thousands of acres of woodland, mostly oak, largely divested of leaves. The caterpillars were starving and were crawling about in search of food. Many were

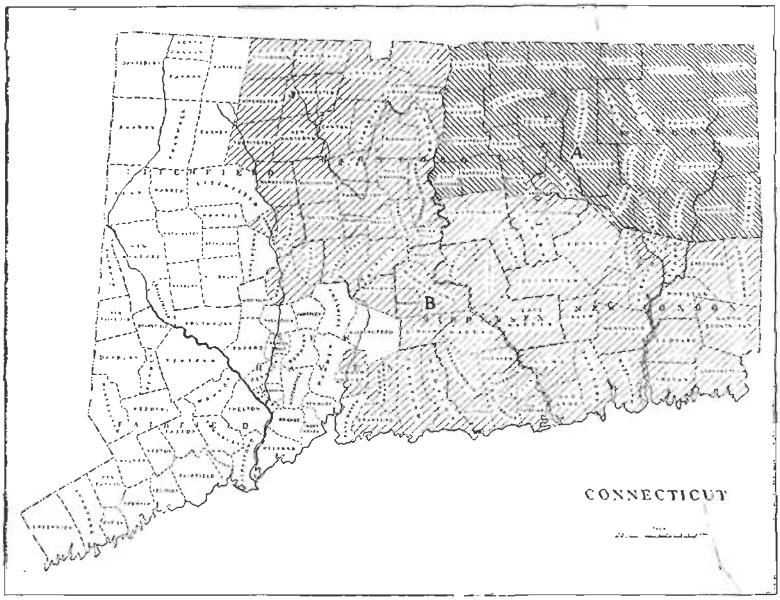

FIG. 38. Map of Connecticut showing areas under Federal and State quarantine on account of the gipsy moth. *A*, area generally infested; *B*, area lightly infested.

hanging limply from trunk and twig, having been killed by the wilt disease. The caterpillars do not practice economy in their feeding, but instead of devouring all of the leaf tissue, they often cut off portions of the leaf blades, which drop to the ground. In this park the ground was literally covered with the dried pieces of leaves cut off by the caterpillars. This material was wholly wasted as caterpillar food, for as soon as it became dry the caterpillars could not eat it. Some of the defoliated trees are shown on Plate XXII.

The Gipsy Moth Quarantine

The Federal quarantine concerning the gipsy moth is considered each year and, if certain changes seem to be necessary, the quarantine is revised accordingly. One revision has occurred during the past year, and Fig. 38 shows the present quarantined area in Connecticut. The quarantine order follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
New Haven, Conn.

QUARANTINE ORDER No. 14
Concerning the Gipsy Moth

Inasmuch as the Federal gipsy moth quarantine has been revised and became effective July 1, 1927, it seems best to likewise revise the State quarantine, so that both Federal and State requirements will be uniform. The areas quarantined on account of the gipsy moth in Connecticut were plainly set forth in Quarantine Order No. 9, effective September 20, 1926, and published with map in Bulletin of Immediate Information No. 54, dated October 1, 1926.

Therefore I do hereby declare the towns of Goshen and Litchfield, in Litchfield County, to be free from said quarantine regulations from this date.

Dated July 20, 1927.

W. L. Slate, *Director,*
Connecticut Agricultural Experiment Station.

Approved:
J. Edwin Brainard,
Acting Governor.

OPERATIONS FOR THE CONTROL OF THE EUROPEAN CORN BORER

W. E. Britton and M. P. Zappe

Since the first appearance of the European corn borer, *Pyrausta nubilalis* Hubn., in Connecticut, the scouting and clean-up work have been conducted by this Department and the Federal Bureau of Entomology working in close and harmonious co-operation. An expression of our appreciation and thanks are hereby extended to the Federal men, especially to Mr. L. H. Worthley, administrator in Corn-Borer Control, and to Mr. R. A. Vickery, Assistant Entomologist, in immediate charge of Federal operations in the Connecticut region. Without this hearty Federal co-operation very much less could have been done, with the available State funds, to hold this pest in check.

The succeeding pages give brief accounts of the scouting and control work done in Connecticut in 1927, a summary of Connecticut infestations, and of the establishment of a quarantine.

1926 Infestations

East Lyme.—The clean-up work in this town was nearly completed in December, 1926, when a fall of snow made it necessary to postpone further operations until spring. On March 15, clean-up work was resumed, only two days with the force of men being required to complete the burning in the gardens of the village of Niantic.

Waterford.—There were four separate infestations in Waterford, three of which were on one farm, and the fourth in a garden about one-fourth of a mile distant. The garden area with surrounding weeds was burned over first. The three infestations on the farm were in large corn fields. Most of the corn had been cut and put into the silo, though some was left in the field and some scattered around the farm buildings and along the roadways. All the corn stalks, stubble, and weeds from the field were gathered and burned. Some adjoining fields where potatoes and cabbages had been grown also contained many large weeds, and these were burned over. Altogether, about 40 acres of land were burned over in Waterford.

New London.—There were two infestations in New London, one in a half-acre corn field on Park Street, in the northwestern part of the city, and the other on Montauk Avenue in the southern portion. Both areas were burned over, together with surrounding gardens and weed areas. Altogether, four acres of land were cleaned up in New London. The Park Street area was first found infested with the European corn borer in 1925, and apparently the control measures that year did not entirely eradicate the pest. At least it was again found infested in 1926 and again cleaned up. Though scouted thoroughly in 1927, no borers were discovered.

Groton.—This was the first town in which the European corn borer was found in Connecticut, in 1923, and infestations have been discovered there each year since. For two years the borough of Groton was infested, and one year two infestations were found on the Groton side of the Mystic River. The village of Noank has been infested since the summer of 1925, and though clean-up work has been done each season, the village remains infested. Usually, several infestations have been found each year, but all were in back-yard gardens in the more thickly settled part of the village, and in the clean-up work were treated as one infestation. A majority of the people here are fishermen and lobstermen, and the yards are usually filled with nets, boats, lobster pots, and sheds. It is difficult to burn the corn stalks and weeds without injuring the nets and other property. In the spring of 1927, all corn stalks, weeds, and other plant material which might harbor the borers were removed from the vicinity of the fish nets and then burned. Yards containing no fishing gear were burned over as in other infestations, and altogether about 10 acres were covered. Still, later in

the season of 1927, Federal scouts found the corn borer present in Noank.

Stonington.—In 1926, three separate areas were found infested in the town of Stonington. One was in a small garden in the borough of Stonington, where the clean-up work was a simple matter; another was on Lord's Hill, where two borers were found in a small field of sweet corn; the third area was in the village of Mystic, where several yards were infested. On Lord's Hill, all corn stalks, weeds, and flower stalks in and around the infested field were burned. The owner of the farm feeds his cattle out of doors on corn stalks grown elsewhere on his farm, and all stalks and pieces of stalks left by the cattle were gathered and burned. In the village of Mystic all infested yards and weed areas were burned over. Just south of the railroad station are a few infested corn fields, which were all burned over. About 26 acres of land in Stonington were cleaned up in the spring of 1927.

Summary of Clean-Up Work on the 1926 Infestations

Control operations were carried on in the towns of Milford and East Lyme, from November 16 to December 9, 1926, and recorded in the Report of this Station for 1926 (Bulletin 285), page 239. The work was resumed from March 16 to April 27, 1927, in the towns of East Lyme, Waterford, New London, Groton, and Stonington. All clean-up work was conducted in co-operation with the Federal Bureau of Entomology, which furnished a burner, a ton truck, and part of the labor for both fall and spring operations, and all of the oil used in the spring. The area burned over is given below.

Area Burned

Town	No. Acres
East Lyme	11
Groton	10
Milford	4
New London	4
Stonington	26
Waterford	40
Total	95

Scouting in 1927

During the summer of 1927, Federal men scouted 58 towns in Connecticut, including all shore towns except New Haven, and several towns adjoining shore towns, all towns bordering on Rhode Island except Voluntown, three towns in the northwest corner of the State, and four towns in the center of the State where seed corn is grown. The State of Connecticut paid the wages of the Scouts for a brief time. The towns scouted were as follows:

NEW LONDON COUNTY

East Lyme	Lyme	Old Lyme
Groton	Montville	Stonington
Ledyard	New London	Waterford
	North Stonington	

MIDDLESEX COUNTY

Chester	Essex	Saybrook
Clinton	Killingworth	Westbrook
	Old Saybrook	

NEW HAVEN COUNTY

Bethany	Madison	Oxford
Branford	Milford	Seymour
East Haven	North Branford	Southbury
Guilford	North Haven	West Haven
Hamden	Orange	Woodbridge

FAIRFIELD COUNTY

Bridgeport	New Canaan	Stratford
Darien	Newtown	Trumbull
Fairfield	Norwalk	Weston
Greenwich	Shelton	Westport
Monroe	Stamford	Wilton

LITCHFIELD COUNTY

Canaan	North Canaan	Salisbury

HARTFORD COUNTY

Glastonbury	Newington	Wethersfield
	Rocky Hill	

WINDHAM COUNTY

Killingly	Putnam	Thompson
	Sterling	

The northwest corner towns were scouted because the large infestation around Albany, N. Y., has spread almost to Connecticut, but no corn borers were found in Canaan, North Canaan, or Salisbury. Likewise, the large infestation in eastern Massachusetts and Rhode Island has extended nearly to the Connecticut border, and all towns adjoining Rhode Island except Voluntown were scouted. No borers were found in these border towns except in Stonington.

There is an area south of Hartford devoted to seed growing, and considerable sweet corn is raised for seed. Though the towns of Glastonbury, Newington, Rocky Hill, and Wethersfield were scouted carefully, no signs were found of the European corn borer.

In the examination of the shore towns by Federal scouts, the only infestations found were in Milford, East Lyme, Groton, and Stonington. Nothing was found in Waterford and New London, both of which were infested in 1926. After the scouting described

above was nearly finished, Mr. A. P. Harger, who assisted us in nursery inspection, returned to his home in the Quaker Farms section of Oxford, and noticed a borer in an ear of sweet corn. He brought the specimen to the Station, and it was afterward sent to the Federal Corn Borer Laboratory at Arlington, Mass., and identified as the European corn borer. Federal scouts were at once placed in Oxford and scouted not only the entire town but all adjoining towns. Only a few borers were found in Oxford, and these were in two separate infestations, in small corn patches perhaps a half-mile apart. None were found in the surrounding towns.

Stonington

The infestations found in Stonington were near the village of Mystic, and near the village of Stonington, particularly toward the north and east. At Mystic the infestations were: one just south of the railroad station, two east of the village on what are known locally as the Industrial Place and the Hewitt Farm. Another infestation was found at Fair Acres, about two miles north of Mystic, where borers were found in 1925 but not in 1926. The infestations near the village of Stonington were all north of the railroad station and northeastward along the Post Road toward Westerly, R. I. One of these infestations was at Wequetequock about two miles from the borough of Stonington. In 1926 only one small garden was found infested in the borough, and it was well cleaned up.

Altogether, 16 separate fields were found infested with 90 larvae of the European corn borer in the town of Stonington in 1927. No clean-up work has been done, but plans for spring burning are now under way.

Groton

In Groton the 1927 infestations were in two localities: one at Noank, which has been generally infested for several years, and the other on Fort Hill, about one and one-half miles northwest of Noank. The latter infestation was discovered in a field of sweet corn on the Groton town farm, where it will be necessary to clean up the corn, stubble, and weeds on several large fields. At Noank the infestations were all in back-yard gardens, and the entire village will need to be covered in the control operations in early spring.

East Lyme

All infestations in East Lyme were either in back-yard gardens in the village of Niantic, or on small farms just west of the village. This town was one of the first to become infested with the Euro-

pean corn borer, and except for the year 1925, has been infested each year since. Altogether, 17 fields and 140 borers were found in East Lyme in 1927. It is estimated that a thorough clean-up of East Lyme will require that about 35 acres of corn and weeds be burned over in the spring.

Milford

One corn field in the Woodmont section of Milford was found infested in 1926, and careful and thorough clean-up work was done. In 1927 nothing was found in the vicinity, but another infestation was found about two and one-half miles westward, where nine European corn borers were discovered in four corn fields. Three of these fields were on one farm and the fourth on another. Between November 16 and 25, a force of 13 men cleaned and burned over the infested fields and all adjoining fields of corn and weeds. Some of these fields had been seeded to grass between the corn rows, and in such fields the stalks were pulled up, carted away and burned elsewhere, in order not to injure the stand of young grass. This work meant much hand labor, but the stalks and weeds burned with the addition of little or no oil and needed the attention of only one man. The land owners appreciated the danger of allowing this pest to increase or spread and willingly co-operated in the clean-up work. About 18 acres of corn and weeds were burned over in Milford, requiring 91 man days of labor and 5,240 gallons of furnace oil.

Oxford

As has been mentioned, the European corn borer was found in two patches of sweet corn about a half-mile apart in the Quaker Farms' section of Oxford. The clean-up work was done from November 25 to 29, and required 48 man days of labor and 2,120 gallons of furnace oil.

Summary of Connecticut Infestations

Each year for the past five years, the European corn borer has been found at one or more points in Connecticut, though the State is not generally infested. Until 1927, all the infestations occurred in the shore towns. In each case the fields were cleaned and the corn stalks and weeds burned. It is interesting to note that New Haven, Old Saybrook, and Old Lyme have each been found infested only once; Groton, where the first Connecticut infestation was discovered in 1923, has been infested each year since, and Stonington has also been infested each year beginning with 1924.

The following table shows at a glance just where and when infestations have occurred in Connecticut.

European Corn Borer Infestations In Connecticut

Towns	1923	1924	1925	1926	1927
Bridgeport		x	x		
Milford				x	x
Oxford					x
New Haven		x			
Old Saybrook			x		
Old Lyme		x			
East Lyme	x	x		x	x
Waterford				x	
New London			x	x	
Groton	x	x	x	x	x
Stonington		x	x	x	x

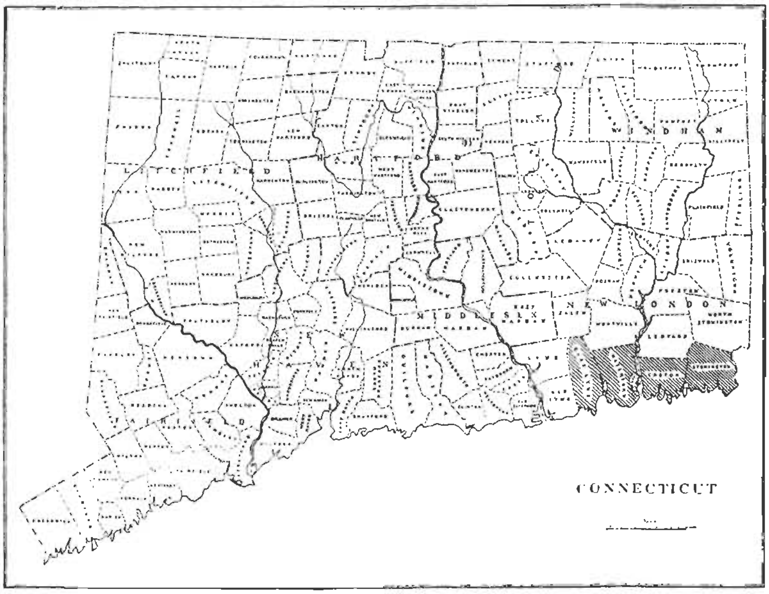

FIG. 39. Map of Connecticut: shaded area shows towns now under Federal and State quarantine on account of European corn borer.

The European Corn Borer Quarantine

The following quarantine order and explanations were published June 1, 1927 as Bulletin of Immediate Information No. 59:

Each year since 1923, a few infestations of European corn borer, *Pyrausta nubilalis* Hubn., have been found by Federal scouts in Connecticut, all being at points along the coast. In each case, corn stalks, stubble, weeds and rubbish have been burned around each infestation, and in some instances no infestation has since been found in the locality. Most of the infestations have occurred in New London County. In 1927, the infested towns were found to be connected through Rhode Island with the large infestation

in eastern New England, and it seemed best to place this territory under quarantine. The Federal quarantine on the towns of East Lyme, Waterford, New London, Groton, and Stonington became effective March 1, 1927, and applies to interstate shipments from these infested towns. After due notice, a hearing was held at New London, May 13, 1927, and a State quarantine placed on these towns by the following Quarantine Order:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

QUARANTINE ORDER NO. 13

EUROPEAN CORN BORER QUARANTINE

The fact has been determined by the Secretary of Agriculture that an injurious insect, the European corn borer, *Pyrausta nubilalis* Hubn., not heretofore prevalent or widely distributed in Connecticut, exists in the towns of East Lyme, Waterford, New London, Groton and Stonington, now, since March 1, 1927, under Federal quarantine. After due notice, a public hearing was held at New London, May 13, 1927, where all persons interested were given a chance to appear and be heard.

Now, therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 107, Public Acts of 1925, do hereby proclaim that the said towns of East Lyme, Waterford, New London, Groton and Stonington are placed under state quarantine, and that it shall be unlawful to move from this area to other points within the state, such plants and plant products, and those only in compliance with the rules and regulations as are designated on the following pages.

RULES AND REGULATIONS

Regulation 1.—Definitions.

For the purpose of these regulations the following words, names, and terms shall be construed, respectively, to mean:

(a) Corn borer: The insect known as the European corn borer (*Pyrausta nubilalis* Hubn.).

(b) Regulated area: Those portions of the state quarantined on account of the European corn borer and designated as being infested or immediately threatened with such infestation.

(c) Inspector: An inspector of the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

Regulation 2.—Plants and Plant Products Subject to Restriction.

Until further notice, unless accompanied by a certificate or permit issued by an authorized inspector, the following plants and plant materials cannot be allowed movement out of the restricted area: Corn, broom corn (including all parts of the stalk), all sorghums, sudan grass, celery, green beans in the pod, beets with top, rhubarb, oat and rye straw as such or when used as packing, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolus and dahlia, except the bulbs thereof.

No restrictions are placed by this quarantine on the movement of the articles enumerated, when they shall have been manufactured, processed, or treated in such manner that in the judgment of the inspector no infestation could be transmitted.

Regulation 3.—Infested Areas.

The towns of East Lyme, Waterford, New London, Groton and Stonington, in New London County, Connecticut.

Regulation 4.—Control of Movement of the Restricted Plants and Plant Products.

The movement of the articles enumerated shall not be allowed to any point outside of the areas designated as infested by the corn borer, unless and until such articles have been inspected by an inspector and certified to be free from the corn borer: *Provided*, That certification for movement of corn and broom corn shall be restricted to clean shelled corn and clean seed of broom corn: *Provided further*, That with respect to any article found to be infested with the European corn borer disinfection or treatment may be authorized by the inspector as a condition of certification for interstate movement when in the judgment of the said inspector such disinfection or treatment will eliminate all risk of transmission of infestation—such treatment to be under the supervision of and satisfactory to the said inspector.

The restrictions of these regulations shall apply throughout the year to corn, broomcorn (including all parts of the stalk), all sorghums and sudan grass, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolus and dahlia, except the bulbs thereof without stems; and for the period between June 1 and December 31 to celery, green beans in the pod, beets with tops, rhubarb, and oat and rye straw as such or when used as packing.

No restrictions are placed on the movement from an area not under regulation through a regulated area of the articles when such movement is made on a through bill of lading.

Regulation 5.—Marking and Certification a Condition of Interstate Transportation.

Every car, box, bale, or other container of plants and plant products of which inspection is required by these regulations shall be plainly marked with the name and address of the consignor and the name and address of the consignee, and shall bear a certificate showing that the contents have been inspected by an authorized inspector and found to be free from corn borer infestation.

The inspection certificates in the case of carload and other bulk shipments shall accompany the waybills, conductors' manifests, memoranda, or bills of lading pertaining to such shipments.

Certificates of inspection will issue only for plants and plant products which have been actually inspected by the United States Department of Agriculture or the Connecticut Agricultural Experiment Station: *Provided*, That when in the case of individual premises or districts within an infested area in any of the quarantined states it shall be determined by competent inspection that the corn borer does not infest any of the cultivated products grown in such premises or districts and that said premises or districts have been maintained in such condition of freedom from weeds or vegetable growths other than the cultivated products designated as to prevent possibility of occurrence of the corn borer through such agencies, a certificate good for not to exceed 30 days may be issued by the inspector stating that such premises or districts have been inspected and found free from the corn borer and free from weeds or other extraneous vegetation capable of harboring the corn borer, and authorizing the shipment from said premises or districts of any of the articles subject to this quarantine grown therein. Copies of such certificate shall be attached to small packages, or, in the case of bulk shipments, to waybills, conductors' manifests, memoranda, or bills of lading pertaining thereto. Reinspection of the premises or district shall be a condition of the granting of further certification.

Regulation 6.—Conditions under Which Plants and Plant Products Originating Outside of the Infested Areas May Be Shipped from Points Within the Infested Areas.

Plants and plant products of which the movement is restricted by these regulations which originate outside of the infested area quarantined for the corn borer may be shipped from points within the infested areas to points outside such areas under permit from the inspector. Permits will issue only for plants and plant products which are not infested with the corn borer, and transportation companies shall not accept or move from within the infested areas such plants and plant products originating outside the infested areas unless each shipment is accompanied by a permit issued by an authorized inspector.

Regulation 7.—Conditions Governing Inspection and Issuance of Certificates

Persons intending to move or allow to be moved plants and plant products for which certificates of inspection are required by these regulations will make application therefor as far as possible in advance of the probable date of shipment. Applications should show the nature and quantity of the plants or plant products which it is proposed to move, together with their exact location and, if practicable, the contemplated date of shipment. Applicants for inspection will be required to assemble the articles to be inspected and so to place them that they can be readily examined. If not so placed, inspection may be refused. All charges for storage, cartage, and labor incident to inspection other than the services of inspectors, shall be paid by the shipper.

Regulation 8.—Thorough Cleaning Required of Cars, Boats, and Other Vehicles before Moving Interstate.

Cars, boats, and other vehicles which have been used in transporting within the infested areas plant products covered by these regulations or any other articles which may hereafter be made subject thereto shall not be moved or allowed to move unless the same shall have been thoroughly swept out and cleaned by the carrier at the point of unloading or destination of all litter and rubbish from such regulated articles. No litter, rubbish, or refuse from any such plants and plant products shall be moved or allowed to move.

Regulation 9.—Provision for Inspection of Restricted Plants and Plant Products in Transit.

Any car, box, bale, or other container of plants or plant products moved or offered for movement, which contains or may contain plants or plant products the movement of which is prohibited or restricted by this quarantine and these regulations, shall be subject to inspection by duly authorized inspectors, at place of shipment or destination or at any point en route.

Regulation 10.—Shipments by the Connecticut Agricultural Experiment Station or the United States Department of Agriculture.

Plants and plant products the movement of which is restricted by these rules and regulations may be moved by the Connecticut Agricultural Experiment Station or the United States Department of Agriculture, when intended for experimental or scientific purposes, on such conditions and under such safeguards as may be prescribed by the Federal Horticultural Board.

This order including rules and regulations shall take effect June 1, 1927, and shall be in force until further notice.

W. L. Slate,
Director, Connecticut Agricultural Experiment Station

Approved:
John H. Trumbull,
Governor.

Of course the purpose of the quarantine is to prevent the shipment of infested material, and it will be unlawful to transport any of the plants or plant material named in the quarantine order to any point outside of the infested area without a permit or certificate. No certificate will be needed for such shipments within the quarantined area.

Penalty

Chapter 107, Public Acts of 1925, provides that "Any person interfering with the performance of such duty or violating the quarantine regulations established under this act shall be fined not less than ten nor more than fifty dollars."

Published Rules and Regulations

Copies of the revised rules and regulations connected with the quarantines established on account of the European corn borer may be obtained from the following sources:

Connecticut Agricultural Experiment Station, New Haven, Conn.
Mr. R. S. Clifton, 12 South Market St., Boston, Mass.
Federal Horticultural Board, Washington, D. C.

Inspections

Arrangements have been made to have a Federal inspector stationed in New London, and he will inspect both interstate and intrastate shipments. His name, address, and telephone number are given below. Applications for inspection should be made to

Mr. Andrew B. Anderson,
Fisher Florist, Inc.,
104 State Street,
Telephone 44 New London, Conn.

FURTHER REPORTS ON SPRAYING AND DUSTING OF APPLES

M. P. Zappe and E. M. Stoddard

This work has been continued in the Frank N. Platt orchard in Milford, where similar experiments have been conducted since 1921. The trees in this orchard are twenty-three years old, growing in sod with nitrate of soda as a fertilizer, and are in good growing condition. Most of them have too much wood, making the operation of spraying and dusting rather difficult and resulting in a large number of small, poorly colored apples. The varieties are: Baldwin, Greening, Gravenstein and McIntosh. The results of former experiments on this subject made by this Station have been published in the Station bulletins and reports as follows: Report for 1920, page 168; Bulletin 235; Bulletin 245; Report for 1923, page 267; 1924, page 286; 1925, page 272; and 1926, page 228.

Acknowledgments

The writers are indebted to Mr. Frank N. Platt for use of his orchard, power sprayer, and other assistance in conducting the experiments; also to Messrs. B. H. Walden, H. B. Bender and A. D. McDonnell, who assisted in scoring the fruit at harvest time. We also wish to acknowledge the assistance of Dr. Florence A. McCormick in making many laboratory examinations of apple scab in various stages of development.

Arrangement of Plots

The arrangement of plots in 1927 is the same as in 1926. The orchard was divided into seven plots of two rows, each running across the orchard, to include all varieties in each plot. One of these plots was used as a spray barrier to prevent dust from blowing upon the trees of the check plot, and no data from the barrier plot are used in making comparisons. The arrangement of plots and schedule of treatment are shown in the following table:

Arrangement of Plots and Spray Schedule

	1 Pre-pink April 25	2 Pink May 5	3 Calyx May 23-26	4 1st after Calyx June 8	5 2d after Calyx July 7	6 3d after Calyx August 3
Plot 1 Rows A & B	Spray	Spray	Spray	Spray	Spray	Spray
Plot 2 Rows C & D	Pomodust	Pomodust	Pomodust	Pomodust	Pomodust	Pomodust
Plot 3 Rows E & F	Kolotex Dust	Kolotex Dust	Kolotex Dust	Kolotex Dust	Kolotex Dust	Kolotex Dust
Plot 4 Rows G & H	Spray	Spray	Spray	Pomodust	Pomodust	Pomodust
Plot 5 Rows I & J	Spray	Spray	Pomodust	Pomodust	Pomodust	Spray
Plot 6 Row M	Check; no treatment	Check; no treatment	Check; no treatment	Check; no treatment	Check; no treatment	Check; no treatment

Only the McIntosh variety received the pre-pink applications of spray and dust.

Materials and Apparatus Used

SPRAY

Dry lime-sulphur	6 pounds
Lead arsenate	3 "
Water	100 gallons

POMODUST

Sulphur	90 pounds by weight
Lead arsenate	10 " " "

KOLOTEX DUST

Sulphur	85 " " "
Lead arsenate	15 " " "

All spray applications were made with a Friend Power Sprayer carrying about 175 pounds pressure. Spray rods were used except for the tops of the tallest trees which could not be reached with rods; then a spray gun was brought into use.

Dust applications were made with a Niagara duster. The dust and spray applications were usually made on the same day except at the time of the calyx treatment. At this time it began to rain after the dust had been applied and continued to rain for the next two days, when the spray application was made. The quietest part of the day was selected for dusting, usually either early in the morning or late in the afternoon or evening when the wind had stopped.

Method of Recording Data

The data on results of treatment were taken as in previous years. The method, in brief, consisted of examining all the apples from selected trees in each plot and recording the several injuries and perfect fruit on a series of tally registers arranged on a board so placed on a sorting table that each person scoring fruit could record his own data. This scoring device is described in detail in the Report for 1925. page 273. A total of 130,610 apples were scored on the three varieties used this season. The fruit crop in general was quite light, and on the Gravenstein trees the fruit was so scarce that none was scored and no results on this variety can be presented this year. In certain plots some difficulty was experienced in finding Baldwin and Greening trees with enough fruit to warrant recording the data from them, and some trees had no fruit whatever. The McIntosh trees produced a fairly good crop.

Results of Treatment on McIntosh

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
	Spray	Pomodust	Kolotex dust	Spray 1, 2, 3 Dust 4, 5, 6	Spray 1, 2, 6 Dust 3, 4, 5	Check
Good	56.7	55.	63.03	44.9	36.6	.47
Aphis	3.39	3.44	4.17	5.78	5.02	12.42
Red bug	.27	.41	.44	.99	.74	13.31
Codling moth	.11	.197	.09	.12	.11	2.19
Curculio	1.67	3.24	3.14	1.99	3.89	56.9
Eulia	.5	.99	1.15	.52	.58	1.2
Other chewing insects	4.19	9.83	13.18	8.66	10.87	31.3
Scab	36.96	32.7	17.66	45.4	55.6	96.1

Discussion of Results

Kolotex dust gave the best control of scab, while spray and Pomodust were nearly equal. Our records show that the maximum scab spore discharge was at the time of the calyx (May 23-

26), during a three-day rainy period. This rain interfered with the calyx application, the dust being applied just before, and the spray just after the rainy period. This probably accounts for the large amount of scab on the sprayed plots. The difference between the two dusts may be due to the better sticking qualities of the Kolotex dust. There was no sooty blotch or fruit speck present on the McIntosh apples. Red bug was controlled very well by all treatments. The control of curculio was very good for all treatments and much better on this variety than on either of the other varieties. In all cases the amount of curculio injury on the check trees was heavy, but the percentage of injury was less on the McIntosh than on either Greening or Baldwin. The Eulia injury was very light on this variety.

RESULTS OF TREATMENT ON GREENING

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
	Spray	Pomodust	Kolotex dust	Spray 2, 3 Dust 4, 5, 6	Spray 2, 6 Dust 3, 4, 5	Check
Good	54.4	57.5	54.7	56.7	48.3	5.16
Aphis	28.4	13.8	18.1	21.4	19.8	14.2
Red bug	.25	.17	0	0	.06	24.2
Codling moth	.38	.40	.78	.37	.41	11.3
Curculio	11.38	17.3	17.2	11.4	14.9	60.1
Eulia	3.29	4.85	3.22	3.81	2.74	4.12
Other chewing insects	2.37	7.45	5.4	3.22	5.19	19.6
Scab	2.3	.74	1.4	.4	1.07	3.87
Sooty blotch	2.14	1.07	4.2	.58	5.46	33.2
Fruit speck	1.83	1.82	3.85	4.2	12.9	15.2

DISCUSSION OF RESULTS

The amount of good fruit was nearly the same on all treatments. The per cent of aphis injury is very much less on check trees than on any of the treated plots. This fact has been noted several times during these experiments and has recently been explained by the fact that aphids are attracted by the white color of the dusts and spray residues, and by the fact that some of their parasites are killed by the treatments.* Good control of red bug and codling moth was obtained by all treatments, with only a fair control of curculio on all plots but best on those having liquid spray. Eulia injury was heavier on this variety than on the McIntosh but not as heavy as on Baldwin.

* Folsom, J. W. Jour. Ec. Ent., Vol. 20, page 840.

Results of Treatment on Baldwin

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
	Spray	Pomodust	Kolotex dust	Spray 2, 3 Dust 4, 5, 6	Spray 2, 6 Dust 3, 4, 5	Check
Good	59.2	64.5	30.6	60.7	26.6	1.62
Aphis	21.7	16.1	34.4	15.06	28.9	1.97
Red bug	0	0	1.25	.19	1.21	5.59
Codling moth	.51	.92	0	.46	.28	1.54
Curculio	7.95	11.5	17.1	13.2	16.01	48.2
Eulia	5.15	4.25	2.39	1.01	2.23	40.2
Other chewing insects	3.35	4.6	6.84	2.35	5.17	16.3
Scab	0	0	0	.028	0	.43
Sooty blotch	1.28	.92	9.22	3.72	13.47	60.5
Fruit speck	6.32	1.84	20.1	9.2	28.05	45.7

Discussion of Results

On Baldwin the highest percentage of good fruit was from the Pomodust plot. The other dusted plot (Kolotex dust) was very low in good fruit, largely because of the high percentages of aphis and fruit speck. Here, again, the check plot had less aphis injury than any of the other plots. Codling moth injury was very light on all plots, including the check, but curculio injury was heavy and was best controlled by liquid spray. Both Eulia and other chewing insects were plentiful on check trees but were fairly well controlled by all treatments. Sooty blotch and fruit speck were quite plentiful and were fairly well controlled except in the Kolotex dust plot and the combination plot No. 5, receiving both spray and dust.

Summary of Results on All Varieties

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
	Spray	Pomodust	Kolotex dust	Spray 1, 2, 3 Dust 4, 5, 6	Spray 1, 2, 6 Dust 3, 4, 5	Check
Good		G B	M			
Aphis	M	G		B		
Red bug	M B	G B	G			
Codling moth			M B	G		
Curculio	M G B					
Eulia	M			B	G	
Other chewing insects	M G			B		
Scab	B	B	B M	G	B	
Sooty blotch		B		G		
Fruit speck		G B				
	10	9	6	6	2	0

B, Baldwin; G, Greening; M, McIntosh

Summary

As a method of comparison of the relative values of the different treatments we present the foregoing table. In this table the first letter of the variety is arranged opposite the several injuries, under the treatment which gave best control of that particular trouble. For example, the highest per cent of good fruit was obtained by the Pomodust treatment on Greening and Baldwin, and by Kolotex dust on McIntosh.

At the foot of each column may be seen the figures representing the total number of points scored for that particular treatment. It will be seen that liquid spray has a total of ten points, and the second best treatment was Pomodust with nine points. Kolotex dust and the combination plot having the first three treatments of spray and the last three of Pomodust both have six points. The plot having the first, second, and sixth treatments of spray, and the third, fourth, and fifth of Pomodust scored only two points.

The results of the work this year show nothing very striking except the fact that the dust treatments have given better control of scab than the liquid spray, but allowances must be made for the delay in getting liquid spray on the trees at the time of the calyx application when scab infection took place.

CANKERWORMS IN NEW LONDON COUNTY

M. P. Zappe

Cankerworms were very plentiful in several of the shore towns in New London County, and many small groves of trees along the roadsides were nearly defoliated. In the town of East Lyme, at what is known as Point O' Woods, an oak grove was nearly stripped of leaves. The grove consists mostly of white and red oaks. The cankerworms apparently preferred the white oaks, as these were defoliated, while oaks of the red or black type were not so badly injured.

There are many summer cottages in this grove, and hardly any one lives there except during the summer months. When the larvae were most abundant (about June 16), only a few of the summer people had moved into the grove. These people were very much alarmed about the defoliation of their trees. The larvae were nearly full grown, and many were coming down to pupate. Others were leaving defoliated trees for some that still offered some food. Larvae when leaving the trees come down on threads, and it was impossible to walk under the trees without getting

covered with worms. Larvae were crawling all over everything and were very plentiful on the sides of the houses. In some cases they were so abundant that one could hardly see the color of the house. The women were particularly annoyed by larvae crawling into the houses through open windows, doors, etc., and no clothing could be hung out while larvae were present.

Many of the larvae on the buildings were either dead or dying, having been attacked by some of the bacterial diseases which sometimes kill large numbers of larvae in a short time. Predaceous insects and birds were also present and seemed to be killing many

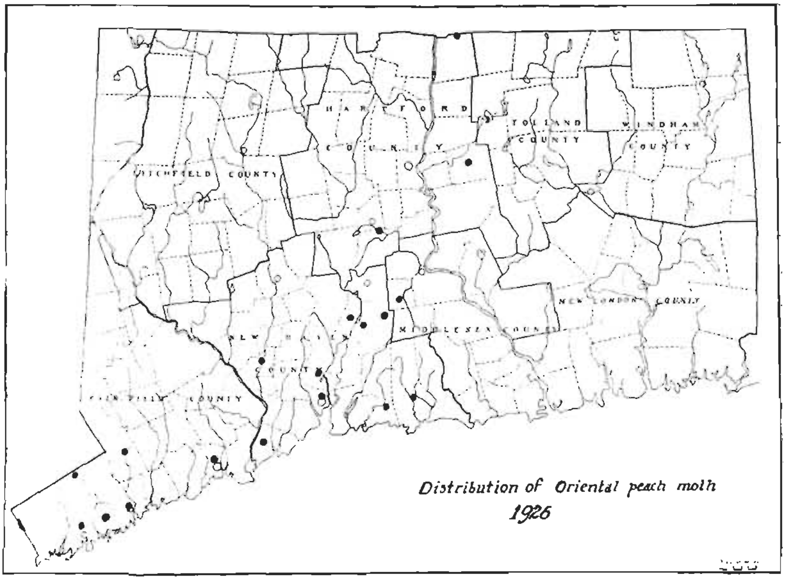

FIG. 40. Map of Connecticut showing recorded distribution of the Oriental peach moth in 1926.

of the cankerworms. One of the large ground beetles, *Calosoma scrutator* Fabr., was doing good work, and the adults were seen on the trunks of the trees, devouring the cankerworms.

We were informed that some cankerworms were present in 1926, but not in such numbers as in 1927. When most of the summer inhabitants arrived, early in July, the cankerworms had all disappeared. Later in the summer the trees had all leafed out again, and few indications could be seen of the early outbreak of cankerworms.

THE ORIENTAL PEACH MOTH IN CONNECTICUT

PHILIP GARMAN

The Oriental peach moth has now been in Connecticut ten years, to the best of our knowledge. Since its first introduction or discovery in 1917, it spread slowly at first, but with more and more speed during the 20's, so that it is found in seven of our eight counties and is becoming very abundant in some localities. During the last season it appeared in all districts where it had been previously found. It now infests nearly every orchard in Fairfield County and is doing great damage in Hartford and Middlesex Counties. It has not yet been found in Windham County, where, however, few peaches are grown. Figs. 40 and 41 show its occurrence in 1926 and 1927, determined by similar means. A comparison of the two charts shows a distinct gain on the part of the peach moth in 1927. There has also been a distinct increase in the infestation of quinces, and we have learned of at least one orchard severely infested in 1927. The only case where we have been able to detect much reduction in fruit injury since the moth became prevalent is in Wallingford where experimental work was done. Here there has been a successively decreasing infestation since 1925, and the infestation this year did not average much over 10 per cent in any part. We attribute this to parasitism, and thorough cultivation of the soil by the owners.

Our work this year consisted of maintaining bait pans, applications of insecticides in the field, cage records, and tests of a number of different larvicides and ovicides, as well as sprays which might prevent the adult moths from laying eggs.

The bait pan work consisted of the maintenance of two lots of bait pans, one a comparison of protected tin pails versus enamel stew pans—consisting of about twenty pails of each kind—and another series comparing rusty tin pails with pails protected on the inside with linseed oil. The total catch during the season is as follows:

COMPARISON OF PROTECTED TIN PAILS WITH ENAMEL STEW PANS

	Average for season per pail
A Tin pails (23) protected on the inside with white paint; outside with linseed oil	28
B Enamel pans (20)	26
Total catch in 43 pails	1167

COMPARISON OF RUSTY PAILS WITH PAILS PROTECTED ON INSIDE WITH LINSEED OIL

A Rusty pails (10)	1.1
B Rusty pails protected with linseed oil (10)	4.6

The bait used was a thick, refiners' syrup diluted 1 quart to 5 gallons of water, or 1 part to 20 parts of water. This syrup seems to work better than the molasses used last year in that it does not ferment quite as rapidly, and the bait does not become choked with noctuid moths during periods when these insects are numerous. However, the usual difficulties were encountered in pail maintenance, namely, the dilution of the bait due to heavy and incessant rainfall during the summer and evaporation during dry periods. It would apparently be desirable if the fermentation could be stopped by the addition of preservatives after the most effective period is reached, since continuation of fermentation results in

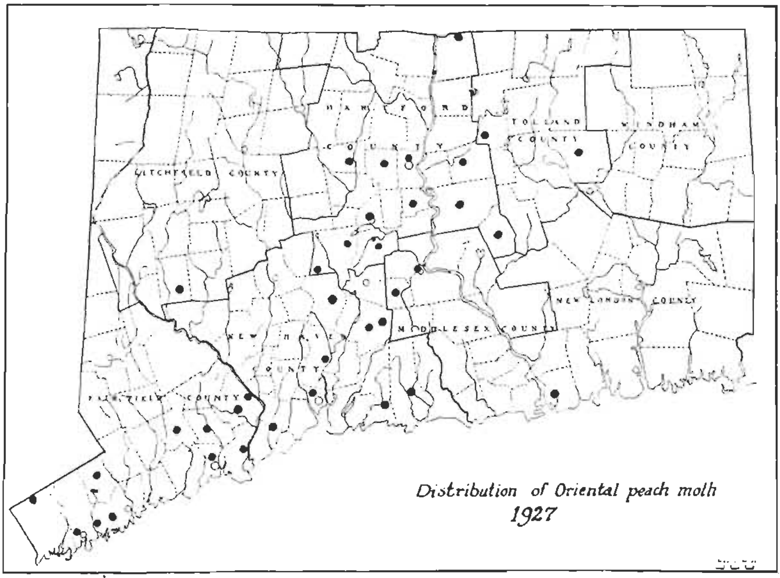

FIG. 41. Map of Connecticut showing recorded distribution of the Oriental peach moth in 1927.

foul-smelling mixtures eventually without any attractive powers whatever. The total catch from 43 pails was 1,167 moths, of which presumably half were females. This means a total of 27 per tree, or 9 per brood per tree. This figure is evidently not high enough to afford protection, since many more may develop on a single tree during the latter part of the season.

It seems advisable to report at this time life-history data including both insectary studies at New Haven and bait pan records obtained at Wallingford. This information is given in the table on page 267 and in Fig. 42. We have been unable to obtain more

than a partial fourth generation, and there have been no signs of this since 1925. Fig. 42 shows the periods of adult abundance in 1926 and 1927 in a commercial peach orchard and indicates that the first adults begin to emerge shortly after the first of May. This also corresponds to our earliest emergence date in the insectary at New Haven, where the first moths emerged April 29. The peak of emergence, however, was not reached until about the first of June in New Haven, and the abundance in bait pans at Wallingford indicates the first of June or later. The moths continue to fly until cold weather, and have been caught several weeks after the crop is harvested. It is evident that a great difference in time of spring emergence is made by the position in relation to sunlight. Observations in cages during 1925 indicated that a

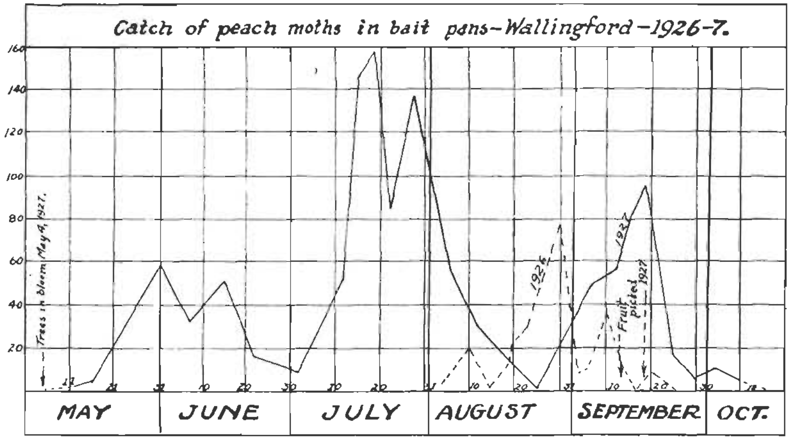

FIG. 42. Periods of adult Oriental peach moth activity in 1926 and 1927. This shows the relative abundance at different periods during the summer.

majority of the larvae spinning on the trunk spin on the north side of the tree. In the orchard, however, they may be found in different locations, although the majority spinning on the tree have been found on the north side. From the following data it will be seen that those protected from sunlight emerge much later than those not thus protected. The moths used in this experiment were all obtained from the same source and were placed in a wire cage with a board partition protecting half the cocoons from the direct rays of the sun. There was no glass between the cage and the sun, and the larvae were placed on a bench in an open insectary. The period of emergence is seen to be somewhat over seven weeks, beginning the 29th of April and continuing until June 23. The cocoons were constructed in paper cells.

RESULTS OF PROTECTION FROM SUNLIGHT ON THE SPRING EMERGENCE OF ADULT MOTHS

Date of emergence		Unprotected from sun	Protected
April	29	2	0
May	1	3	0
	3	1	0
	4	1	0
	5	3	0
	6	2	0
	8	1	0
	12	3	0
	16	0	0
	23	0	1
	28	0	2
	31	0	2
June	3	0	1
	6	0	3
	8	0	1
	9	0	2
	11	0	1
	13	0	1
	14	0	1
	15	0	1
	20	0	1
	22	0	1
	23	0	1
Total		16	19

INCUBATION OF THE EGG—DAYS

Date	First Brood			Second Brood			Third Brood			Fourth Brood			Total observ-ations
	No. observed	Average	Range	No. observed	Average	Range	No. observed	Average	Range	No. observed	Average	Range	
1925	276	9.0	3–13	155	4.8	4–6	39	4.9	4–6	34	7.6	6–11	
1926	268	9.3	6–16	125	4.9	2–6	142	5.3	3–7				
Aver. for 1925–6	344	9.1	3–16	280	4.8	2–6	181	5.1	3–7	34	7.6	6–11	839

LARVAL FEEDING PERIOD—DAYS

	No. observed	Average	Range	No. observed	Average	Range	No. observed	Average	Range				
1925	26	15.4	13–20	42	13.2	10–17	16	16.5	12–28				
1926	63	15.8	12–27	64	12.4	10–21	92	19.8	14–34				
Aver. for 1925–6	89	15.6	12–27	106	12.8	10–21	108	18.1	12–34				403

COCOONING AND PUPAL PERIOD—DAYS

	No. observed	Average	Range	No. observed	Average	Range	No. observed*	Average	Range				
1925	17	13.4	9–17	36	13.3	9–16	11	13.2	12–16				
1926	78	12.8	8–15	72	12.5	8–18							
Aver. for 1925–6	95	13.1		108	12.9	8–18	11	13.2	12–16				
Egg to Adult	Sum	37.8	23–60		30.5	20–45	11	36.4					214

TOTAL PERIOD**—EGG TO ADULT—DAYS

	No. observed	Average	Range	No. observed	Average	Range	No. observed	Average	Range				
1925	30	35.2	29–43	66	32.4	29–38	22	281.7	271–294				
1926	102	39.0	31–49	80	30.3	26–37	56	286.8	259–318				
Aver.	132	37.1	29–49	146	31.3	26–38	78	284.2	259–318				356

*Only those emerging before winter are recorded.

These emergence data combined with bait pan records have an important bearing on the time for cultivation to control the larvae pupating on the ground, in view of which it is recommended that the cultivation be complete by the first of May, if possible, and by no means delayed after the middle of that month.

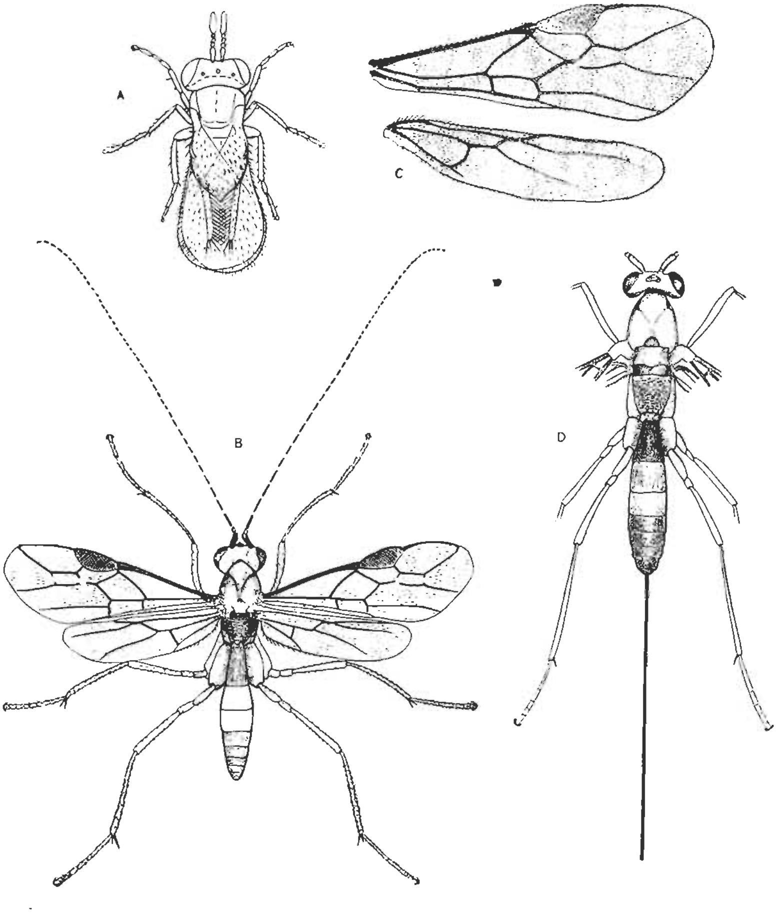

FIG. 43. Parasites of the Oriental peach moth. A, an egg parasite, *Trichogramma minuta* Riley; B, C, D, *Macrocentrus ancylivora* Rohwer; B, male; C, wings of female; D, body of female. All much enlarged.

The parasite *Macrocentrus ancylivora* Rohwer (Fig. 43, b, c and d) was observed to be very numerous at Wallingford, and no doubt was partly responsible for the decrease in infestation there. This insect was originally studied in the United States as a parasite

of the strawberry leaf roller, *Ancylis comptana* Fröhlich. It has been thought that the parasite possibly winters on this host, but a search for the host revealed none in the immediate vicinity of the orchard where the parasite was most abundant. However, there are probably many other leaf rollers which might serve as a winter host, some of which were caught in large numbers in bait pans.

The egg parasite *Trichogramma minuta* Riley (Fig. 43, a) was obtained from California with a view to establishing it in infested orchards. Success has been reported by Flanders* in the control of the codling moth in walnuts, using large numbers reared in the eggs of the Angoumois grain moth, *Sitotroga cerealella* Oliv. Some of these parasites were released, but it will probably be necessary to rear them in large numbers each year for release in infested districts in order to get them established.

A considerable number of preliminary field tests were made with a view to developing an arsenical substitute which might be used safely on peaches. Most of the work dealt with oil emulsions designed for ovicides, and fluosilicates to poison the larvae. Sodium fluosilicate was used but caused burn under ordinary conditions of application. However, the presence of bark cankers is absent, when this material is used, although the foliage may be severely scorched. It was discovered that the addition of ground glue and lime to a mixture containing sodium fluosilicate was successful in prevention of spray burn on the foliage. On early peaches and young trees the applications were harmless. In our field experiments at Wallingford, where some fifty bearing trees were sprayed with the same formula (8 lbs. to 200 gallons), no injury to the foliage was apparent, although the application caused a small amount of fruit crack. However, there was some splitting on unsprayed trees in this orchard, and the damage was therefore considered slight. A modified formula containing flour, sugar, and other ingredients, including fluosilicate used in another orchard, caused severe cracking of the fruit, although there was no apparent injury to the foliage. The effect of these field tests in control of fruit infestations is shown on page 270, and results with this mixture should be read from the "old injury" column. It was also learned that white oil emulsions may be used in this locality on peaches sometimes without injury, at strengths amounting to 2⅜ per cent of oil emulsion—about 2 per cent of actual oil content. In one test three six-year trees were sprayed with drymix, followed by white oil emulsion after the material dried on the foliage. No injury resulted. Combinations of nicotine sulphate, wormseed oil, and oil of citronella with the white oil emulsions were also used without injury.

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* Jour. Econ. Ent., 20:644:1927.

However, satisfactory kills of the eggs were not obtained in insectary tests under 5 per cent strength or 4 per cent on a pure oil basis. Consequently it was thought advisable to add nicotine to the spray mixture as applied in the field in order to increase its killing power.

Work with artificial foods was also continued with results similar to those obtained in 1926. It is evident that larvae feed and develop on these mixtures, in which several instars may be successfully passed. This year small amounts of magnesium citrate and other substances were tried, and the results seemed to be better than last year in the development of the larvae. Several larvae completed the third instar, while one larva passed through the two final instars, pupated, and emerged as adult. The mixture consisted of the following materials:

Confectioners' sugar	10 grams
Citric acid	.5 "
Magnesium citrate	.5 "
Wheat flour, white	50 "
Water	30 cc.

It is noticeable that the periods of existence are greatly lengthened from feeding on artificial mixtures, a condition apparent both in 1926 and 1927.

RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF ORIENTAL PEACH MOTH—1927

Treatment	Average % Infested	New Injury	Old Injury	Variation in % infested	Total amt. fruit examined	Notes
Sprayed	9.2	5.3	3.9	1–16.0 2–13.7 3–17.2 4–8.4 5–5.4 6–8.2 7–5.5	702	Spray dates July 5, July 22, August 29, September 8. This was in addition to regular sulphur dust treatment by owner.
Pail in every tree	13.9	7.8	6.0	1–18.3 2–28.0 3–20.3 4–15.8 5–10.5 6–7.5 7–15.4 8–1.4 9–14.3 10–14.3	775	Pails hung May 1. Material already fermenting when started. Pails filled June 15. First ten, each series filled July 12; all rest July 22; all refilled Aug. 5; first ten, each series, Aug. 25; all rest filled Aug. 30; all refilled Sept. 30.

Treatment	Average % Infested	New Injury	Old Injury	Variation in % infested	Total amt. fruit examined	Notes
Check—dust only	14.5	6.2	8.3	1–21.3 2–33.8 3–34.8 4– 6.9 5–13.7 6–12.1 7– 4.0 8–31.8	747	

Formula used on sprayed plot:

July 5	*Sodium fluosilicate*.......	4 *lbs.*
	Glue....................	4 "
	Lime....................	40 "
	Water...................	200 gals.
July 22	Same with 8 lbs. fluosilicate instead of 4.	
Aug. 25	*White oil* emulsion	4¾ gals.
	Oil of citronella.........	3 oz.
	Nicotine sulphate........	1 pt.
	Water..................	200 gals.
Sept. 8	Same as August 25.	

Recommendations

At the present time our recommendations for control of the Oriental peach moth consist of (1) cultivation before the first of May and continually thereafter until August. Complete cultivation should be practiced, breaking the soil as near to the trunks of the trees as possible. (2) Use of paradichlorobenzene the same as for peach borer control. It is, of course, recognized that these recommendations will not afford complete control but are the best that can be offered at this time.

WEATHER CONDITIONS ACCOMPANYING THE APHID OUTBREAK IN CONNECTICUT IN 1927

Philip Garman

The unusual outbreak of aphids in orchards in 1927 has not been equaled in the State for many years. Not only did the rosy aphis become abundant, but almost every species that occurs on fruits and other plants was abundant and injurious. It is worth while, therefore, to summarize the weather conditions prevailing at the time. In many orchards surveyed at the beginning of the

growing season, few or no aphid eggs were to be found, and in general the aphids and eggs were scarce throughout at this time. Whatever development occurred then must have been due to conditions immediately following this period. It was noticed also that the aphids suddenly disappeared about the middle of July so that, in Connecticut at least, the periods most profoundly affecting plant lice in 1927 lay between the first of May and the middle of July.

The weather during both May and June, 1927, was unusually cool and rainy. The mean daily temperature as shown in Fig. 46 remained between 50° and 60° F. during the whole of May, and

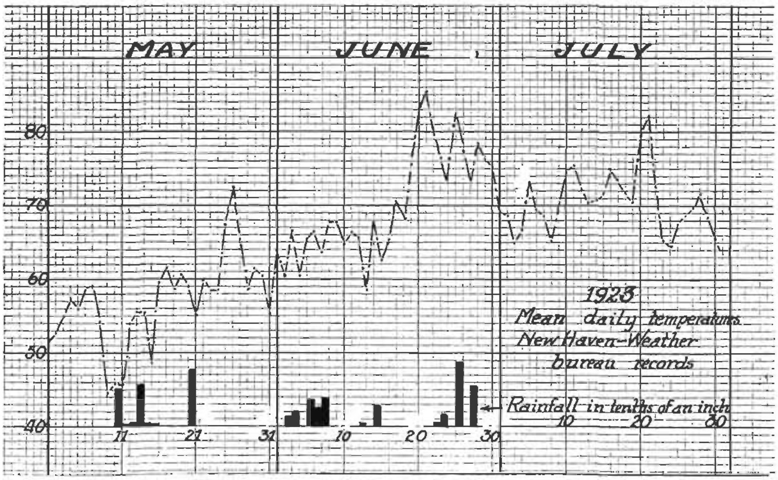

FIG. 44. Rainfall and temperature chart for 1923.

between 60° and 70° during June, rising above 70° only for a few days near the tenth of June and the twenty-third of June, and then only for a day in the orchard. During both May and June the rainfall was nearly twice the normal precipitation.

For comparison, similar diagrams (Figs. 44 and 45) were made for 1925, when aphids were generally scarce, and in 1923, when they were recorded as unusually abundant. The 1923 records show conditions similar to those of 1927 up to June 20, when the mean temperature rose to 80°F., according to New Haven Weather Bureau records. Similarly, during May and June, 1923, the rain-

fall was nearly twice the normal amount. In 1925, there occurred during the early part of June a period of high temperatures when the mean daily temperature averaged above 70° for a week. This was probably effective either in promoting the development of parasites or the increase in migratory instinct among the aphids themselves so that they disappeared from the trees.

During 1926, aphids were moderately abundant, but the weather records indicate only one half the normal amount of rainfall for these two months, although the temperature remained cool, not

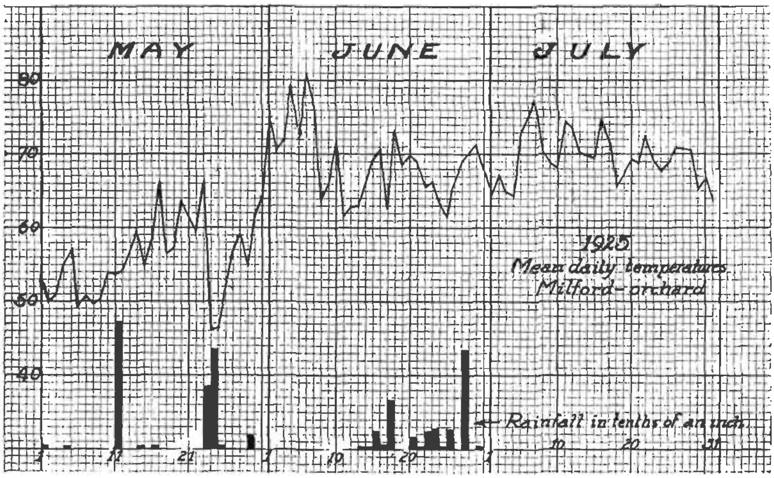

FIG. 45. Rainfall and temperature chart for 1925.

averaging over 70° for any period of time until after the first of July. From this it would seem that abundance of aphids was dependent upon the combined effects of rainfall and temperature. In this connection humidity was also studied, but from the data at hand, as shown in the following table, it is difficult to observe any correlation (even when combined with temperature) between this factor and the abundance of aphids in the field.

COMPARISON OF TEMPERATURES AND HUMIDITIES IN 1925, 1926 AND 1927

Dates		Year	Mean[1] Relative Humidity	Mean[2] relative humidity during day 8 A. M. 8 P. M.	Rainfall[3] Inches	Mean[4] Temperature	Aphid Abundance
May	1–10	1925		55.7	.02	52.2	
	11–20			60.2	1.76	58.1	
	21–31			59.5	2.29	56.5	
June	1–10			65.0	.07	73.6	Light
	11–20			59.0	1.00	66.7	
	21–30			67.5	2.28	66.9	
July	1–10			72.0	1.81	69.2	
	11–20			62.2	.78	70.6	
May	1–10	1926	66.5	54.7	.20	53.8	
	11–20		69.8	62.2	1.04	58.3	
	21–31		68.1	63.8	.32	55.4	
June	1–10		71.8	64.4	.41	58.9	Medium
	10–20		83.5	63.0	.62	59.9	
	20–30		81.0	67.6	.94	65.2	
July	1–10		82.6	66.1	.60	68.9	
	11–20		82.9	72.3	1.69	66.7	
May	1–10	1927	72.7	61.7	1.00	52.3	
	11–20		77.8	71.1	.48	55.1	
	21–31		80.0	74.1	3.16	53.8	
June	1–10		72.0	55.7	1.21	61.4	Very abundant
	11–20		77.0	61.7	.63	60.0	
	21–30		76.0	66.2	1.22	63.9	
July	1–10		79.4	65.4	1.13	65.3	
	11–20		81.5	77.1	.91	72.5	

[1] Mean daily relative humidity from hygrograph obtained in orchard at Milford, Conn.
[2] Average of daily humidities 8 A.M., noon, and 8 P.M. from New Haven Weather Bureau.
[3] Rainfall—midnight to midnight, from New Haven Weather Bureau.
[4] Mean daily temperature, average of 12 records from thermograph sheets obtained in an orchard at Milford, Conn. Machine placed in branches of tree.

In view of the absence of any discoverable relation between humidity and abundance* of aphids in 1926 and 1927, the hythergraphs of the periods between May 1 and July 1 were studied and plotted, as shown in Fig. 47. By first constructing that for 1927, using mean temperatures for each 10-day period between the first of May and the first of July, it appears to be possible to show a relation between these factors and the outbreaks in previous years. Thus, for 1925, two of the figures representing the mean daily temperatures and the combined rainfall for each 10-day period fall within the quadrangle limited artificially by horizontal and vertical lines representing limits of rainfall and temperature.

* See Headlee, Jour. Econ. Ent., 71, page 416, 1914 in this connection.

That year aphids were scarce. In 1923, when they were quite abundant, but not so abundant as in 1927, four periods fall within the limited area, while in 1927 all six periods fall within. Eight periods for 1927 are shown on the chart for the reason that aphids began to disappear only after period 7, or between July 10 and 20. In 1926 (not shown on the chart), four of the six periods fall within the limited area, the others being outside because of the small amount of rainfall or high temperature.

The prediction of an outbreak based upon such data would, of course, be limited by the ability of the weather forecaster to predict similar conditions, but it would seem not impossible to predict such conditions two or three months in advance. It may be also

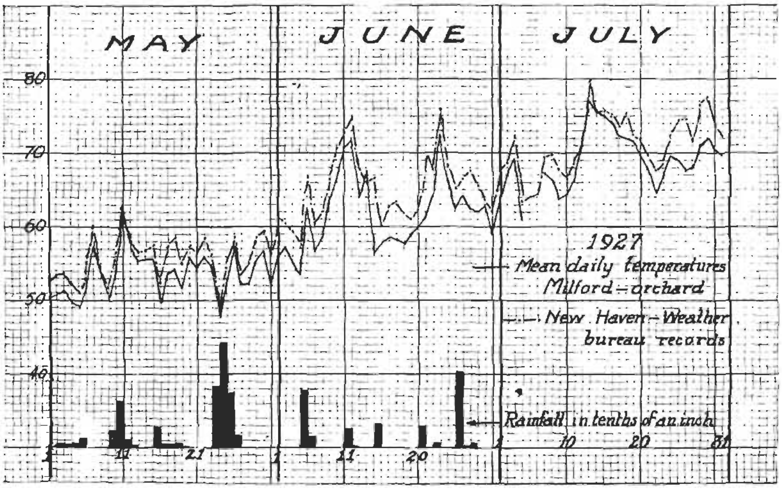

FIG. 46. Rainfall and temperature chart for 1927.

that the limited area does not represent true optimum conditions, but it seems impossible to conceive of a worse outbreak of aphids in general than occurred in 1927, and for this region, at least, probably represents the optimum range of temperature and rainfall necessary for their maximum development.

In connection with rainfall in relation to aphid abundance, it may be that the rank, succulent growth produced by frequent rains plays a much more important role than actual humidity of the air. Thus Headlee (3) showed that some aphids reproduce at a maximum rate provided succulent tissues are available, regardless of humidity (37%-100% relative humidity). Lathrop (4) makes the

statement (page 987) that "plant growth frequently constitutes a factor limiting the rate of development of *Aphis pomi* feeding on slowly growing foliage," while Davidson (2) says, (page 501): "In those series where the soil was treated with complete mineral manures an increased infestation compared with unmanured soil series occurred in every case." It would thus seem that the growth of the plant is most important in aphid outbreaks of the kind experienced in 1927, and it seems reasonable that rainfall should indirectly be a factor of considerable importance. Heavy dashing rains, on the other hand, doubtless destroy many aphids, but from the data available they did not have much influence in keeping down the infestation of last year. Probably a continuous rainy

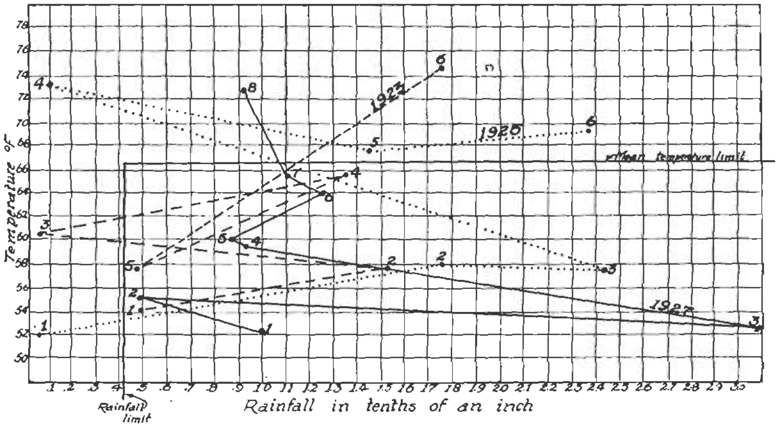

FIG. 47. Combined chart (hythergraphs) showing mean temperature and rainfall by 10-day intervals beginning May 1. Nos. 1, 2, 3, etc., represent intervals from May 1-10; 11-20; 21-31, etc.

period when the ground is kept soaked is more effective in bringing about optimum conditions of growth than infrequent downpours.

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TESTS WITH INSECTICIDES DESIGNED TO DO THE WORK OF NICOTINE SULPHATE

PHILIP GARMAN

The prevailing high price of nicotine sulphate* is leading to considerable activity on the part of manufacturers to produce an insecticide that will take its place. Samples of such products have been received in increasing numbers and it may be worth while to mention here some of the most promising and their effects upon insects.

INSECTICIDES DERIVED FROM DERRIS

Derris is an East Indian plant used as a fish poison. The parts used mainly are the roots from which there are obtained derris resins, the active principle being a so-called tubatoxin. (The root is known by some as tuba root.) It has been well demonstrated that these ingredients are active aphicides working much the same as nicotine sulphate. One of the commercial preparations was tried this year against the mealy plum aphis and showed good killing power, although it failed to accomplish a thorough clean-up on account of poor spread. It is quite evident that soap or casein lime is needed in combination. The product investigated does not mix well with winter strength lime-sulphur solution.

PYRETHRUM EXTRACTS

These materials have been coming into prominence because of their great use in household remedies and the recent demonstration of their general killing ability not only against sucking insects but against such pests as the Japanese beetle and other chewing insects. They have been advertised as almost universal insecticides, one company, in fact, offering a reward for any insect which their product will not kill. It seems evident, however, that any product of this kind cannot wholly take the place of an insecticide like lead arsenate, which remains on the plant for a considerable period, protecting it from invasions of pests not on the plant at the time of the application, and it seems apparent also that there is much to be desired in the way of compatibility with other insecticides and fungicides, if we are to be able to use them extensively. There have been offered three types of pyrethrum insecticides—the kerosene extracts, mostly for household use, the soaps, and the alcoholic extracts.

The soap-pyrethrum combinations will, of course, not be suitable for use in combination with lime-sulphur solution, but they can probably be combined with Bordeaux mixture for use on some crops. It is not advisable to use pure kerosene extracts on any

* The price of nicotine sulphate has dropped since the article was written.

plant foliage. The alcoholic extracts, however, show promise of combining with the usual insecticides and fungicides, but very little is known of them and their effects on plants in combinations with these substances. Likewise, not much is known concerning their keeping qualities; that is, of the original extracts and their possible loss of insecticidal properties.

Both derris and pyrethrum, then, have considerable value as aphicides, but their success for orchard use will depend on their ability to combine with other insecticides and fungicides. The present cost does not seem to be any lower per 100 gallons of spray mixture than nicotine sulphate, and we do not have any reliable information regarding their keeping qualities. The only advantage that can be seen from using the above-mentioned aphicides in an orchard will lie in increased safety of the operator.

TESTS WITH DERRIS AND PYRETHRUM AGAINST THE MEALY PLUM APHIS

	Substance[1]	Dilution	Kill, per cent
A	Derris preparation	1 oz. —6 gals.	88.3
B	"	2 oz. —6 gals.	97.6
C	Pyrethrum soap	2 lbs. —3¾ gals.	94.4
D	Nicotine sulphate	1 oz. —6 gals.	92.2
E	Check—no treatment		0

[1]Commercial preparations in all instances.

THE CARROT RUST FLY

Psila rosae Fabr.

Carrots, celery, parsnips, and parsley are often injured by larvae which tunnel in the fleshy roots. The galleries are rusty in color and are very conspicuous in a parsnip or white carrot, as shown on Plate XXX, b. The tunnels may extend through the root in any direction, and when seriously infested the root may be riddled with burrows. Decay soon sets in and the lower part of the root breaks off in harvesting. Sometimes the infested plants wilt and die.

The insect has long been known as a pest in Europe, and was first discovered in North America in 1885, when carrots purchased in the market at Ottawa, Canada, were found to be mined and infested with maggots. From this material the adult fly was reared. The following spring Dr. Fletcher found the young carrot plants in a garden at Ottawa badly attacked by this insect. In 1897, the insect was reported from Quebec and New Brunswick. In 1901, considerable injury was caused in New York State; at Broadalbin, 6,000 plants were ruined during the season, and traces of the tunnels made by the maggots were found throughout a field of 60,000 plants.

According to Crosby and Leonard,* this insect now occurs in the northern states from Maine to Michigan. It subsists in wild

* Manual of Vegetable-Garden Insects, page 181, 1918.

carrot, and there are said to be two generations each year, though the life history has apparently not been fully worked out in this country.

The eggs are laid in the crevices of the soil around the plant the last of May and hatch in about a week.

The maggot finds its way downward along the root of the plant and begins feeding near the tip of the tap root. Later the larvae tunnel in the fleshy root in all directions. With celery, the fibrous roots are devoured, and the plants take on a pale color and remain stunted. Though some of the maggots of the second brood tunnel in the main root of celery, they seldom enter the leaf stalks.

Parsnips showing the characteristic galleries made by the larvae of this insect were received from Winsted on March 25. Parsnips in my own garden were dug on nearly the same date, and some of the roots were likewise infested. One vegetable grower in Thomaston reports considerable injury from this insect.

At present there is no good method of control. It is hoped that experiments may be conducted towards this end in the near future. Possibly some material for attracting the flies may be discovered, which will aid materially in controlling this pest.

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THE EUROPEAN HEN FLEA IN CONNECTICUT

Ceratophyllus gallinae Schrank

During April the office received a telephone report of a plague of fleas in Madison. As the circumstances seemed rather unusual, Mr. Walden visited the place on April 16. The tenant of the dwelling house had moved in about a month before Mr. Walden's visit. There was a large back yard with a poultry house perhaps 200 feet distant from the dwelling house, which had been vacant since the preceding autumn. On the place was a vegetable garden about 30 x 150 feet, only 25 to 30 feet from the back porch. As the poultry house contained a considerable quantity of hen manure, the tenant had this spread upon the garden and plowed under. The tenant's small child, about two years old, had been out in the yard and was soon covered with blotches on chest and

legs. At first the doctor thought it was hives, but the mother found what appeared to be fleas on the child. An examination showed that the fleas were more abundant on the back porch, on the plowed ground, and especially in the grass around the garden than elsewhere. The poultry house was found to be swarming with fleas. The landlord was notified, sprayed the garden with a mixture of kerosene and burned over the area. Still there were fleas. The garden was then covered with granular quick-lime, and the poultry house was cleaned and limed. At the time of Mr. Walden's visit the fleas were much less abundant than previously, but several were observed and a few collected. Though it was a cold windy day, they were very active and hard to catch. Sweeping with an insect net proved unsuccessful.

The tenants kept on the back porch a garden atomizer filled with a liquid fly killer, with which they sprayed the feet and ankles of any one entering the house from the garden. This liquid was said to kill the fleas.

Apparently the lime was rather effective in killing the fleas. Mr. Walden made a second visit about ten days later and found that the fleas had practically disappeared. Specimens of the fleas were sent to Mr. M. A. Stewart, then at the University of Rochester, who had just finished an investigation for the Crop Protection Institute, in the course of which he announced the presence and rather wide distribution of the European hen flea in this country. Mr Stewart replied, under date of May 13, that the specimens were females of the European hen flea, *Ceratophyllus gallinae* Schrank. This flea is shown on Plate XXIX, b.

This is the first record of the occurrence of this insect in Connecticut. Mr. Stewart has discovered the presence of the pest in different parts of the United States, and has evidence that it is now distributed from Maine to Oregon.* This flea apparently breeds abundantly in nests and on the floors of poultry houses and causes great damage by reducing egg production and the weight of the fowls; thus rendering them unmarketable.

Mr. Stewart has found a satisfactory remedy in Phinotas Disinfectant, a commercial product manufactured by the Phinotas Chemical Company of New York City. This treatment is as follows: Clean the houses of all litter and droppings. Burn the litter and bury the droppings. Dilute the liquid disinfectant with ten times its bulk of water and spray around the floor, walls, ceiling, and roosts, along the principal runways and around the burying pit. Also dip the fowls in the mixture. The dipping should be done in the morning of a sunny day to permit the fowls to become dry as soon as possible.

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* Jour. Econ. Ent., Vol. XX, page 132. 1927.

REPORT OF ACTIVITIES TO CONTROL THE JAPANESE BEETLE IN 1927

W. E. Britton and J. P. Johnson

The work carried on during 1927 was largely of a quarantine nature, such as enforcing the State and Federal Regulations, and scouting for the spread of the Japanese beetle. At this time the towns of Greenwich and Stamford were in the quarantined area. From January 1 until June 15 the quarantine was enforced by Federal men having their office at Mount Vernon, N. Y., and later in New York City. On June 15 the State took over this work and established an office at 682 Main Street, Stamford, Conn. Funds had been appropriated by the State, and these in conjunction with those of the Federal department were used in carrying on the work.

After the summer scouting season was over, the Federal quarantine was extended to include Darien, Easton, New Canaan, Wilton, Norwalk, Westport, Weston, Fairfield, Bridgeport, Shelton, Stratford and Trumbull, becoming effective November 1, 1927. The State quarantine was extended to include the same towns, effective December 1, 1927. The office was moved from Stamford on December 31 to the Hurley Building, Shelton, Conn.

All important roads, totaling 33 in number, were posted with quarantine warning signs to notify the public of the extent of the area and to familiarize them with the regulations.

Scouting

There were two distinct centers from which scouting activities were conducted in Connecticut during the past season. These were Stamford and New Haven.

There were three crews of four men each, and one floating scout operating from the Stamford office. For the first ten days these scouts were stationed in Stamford for the purpose of training them in their work, scouting the towns of Greenwich and Stamford and the vicinity thoroughly. However, no beetles were found, and the entire number of Stamford scouts were taken to Tarrytown, N. Y., for a day's scouting, where beetles were found in small numbers. After this experience the crews were assigned to their summer headquarters; one crew to Norwalk, a second to Danbury, and a third to Bridgeport. The floating scout was sent to Hartford. A crew of three men scouted all classified and unclassified nurseries and greenhouses. No beetles were found. The scouting began July 15 and ended September 7.

The scouting activities were controlled by the man in charge of the Connecticut office, who assigned the areas to be scouted each day, and made periodical visits to the scouting crews. The supervisor visited the crews daily, and carried out the assignments and other orders.

Freight yards, boat landings, city markets, and parks were scouted by the floating scout in Hartford, New Britain, and Waterbury.

The entire scouting force in New Haven consisted of three scouting crews of five men each, one floating scout, and one supervisor. They operated from the Asiatic Beetle Headquarters in Westville, New Haven. All scouting performed east of the Housatonic River was done by them. The daily work was assigned by the man in charge of the Japanese and Asiatic Beetle Control and Quarantine work in Connecticut, and the supervisor visited the crews daily. The crew foremen were experienced men, and after the entire group had scouted in the Asiatic Beetle quarantine area for a few days they were assigned to certain areas in and about New Haven. These men were scouting for the Japanese beetle and Asiatic beetle at the same time.

The floating scout carried on scouting operations in the quarantine area and investigated complaints.

All scouting was performed in the cities, towns, and outskirts. There was not any country-roadside scouting done, as the area was too large to cover, and past experience had proven that there was more likelihood of beetles being found in cities and towns.

Each crew foreman was given instructions to make himself known to the chief of police in each municipality and explain the work in order to avoid confusion and trouble.

Very little trouble occurred during the past season. A few people complained to police headquarters of strangers prowling about, but when the work was explained, the people as a whole coöperated willingly.

The area scouted during the past season included Greenwich, Stamford, Darien, Norwalk, New Canaan, Wilton, Weston, Easton, Westport, Fairfield, Bridgeport, Danbury, Ridgefield, Bethel, Redding, Newtown, Shelton, Stratford, Milford, West Haven, Orange, New Haven, East Haven, Branford, North Branford, Wallingford, Hartford, Hamden, Ansonia, Derby, Waterbury, and Guilford.

Localities where Japanese Beetles were found in 1927 outside the Quarantined Area

Town	Locality	Date	No. Beetles
Bridgeport	West Avenue	August 2, 4	2
	Park Place	2	1
	State Street	3	2
	Washington Avenue	4	186
	Park Avenue	5	1
	Poplar Street	6	2
	Edwin Street	9	16
	Oak Street	13	1
			211
Darien	Railroad Avenue	July 20	1
New Canaan	Park Street	August 12	1

Number of towns where beetles were found, outside the quarantined area 3
Number of beetles found 213

Quarantine Enforcement

During the period of 1927, in which the quarantine regulations were enforced regarding farm products (June 15 to October 1), only the towns of Greenwich and Stamford were in the area under quarantine. This area was not generally infested, the only infestation being on Broad Street, Stamford.

Because of this condition the likelihood was very small that farm produce originating in Connecticut would be infested. Such produce was certified without actual inspection, and as only a small amount originating in Connecticut was shipped from the area, it was possible for the clerk to certify it.

However, there was a situation caused by local commission men in Greenwich and Stamford, mainly the latter, buying their produce from the New York markets, where the possibility of infestation was great, and reconsigning it to the outside area. This produce was inspected before it was allowed to enter the commission houses where it would be mixed with native produce. Two inspectors were needed for this work, necessitating hours from 5 A. M. to 2 P. M. This inspection actually caused certain articles to be inspected which remained in the area, but saved considerable time and labor by refusing to permit the mixing of native produce with that from New York.

Three main roads leading out of the quarantine area were patrolled. The Boston Post Road was the main highway; the other two were much less traveled and needed only intermittent patrol. One man was stationed at each of these two lesser roads, patrolling eight hours a day, except Sundays.

The Boston Post Road required the attention of nine inspectors, which were organized into three crews of three men each. Each crew was on duty eight hours a day, except Sundays, when the

crews were cut down to two men each, while the hours were the same. This highway is the busiest thoroughfare in Connecticut. As many as 22,000 motor vehicles pass over this road in a day, traffic being in evidence at all hours, but the truck traffic mainly going through from late afternoon until morning. During the day passenger cars and moving vans were more numerous, and these were inspected for farm produce, nursery and greenhouse stock. The men did not attempt to stop all the vehicles, as a serious traffic congestion would have resulted.

Practically all nursery and greenhouse stock was in Class 1. This permitted certification without actual inspection and saved considerable labor. However, when there was any doubt as to the origin of the stock, it was thoroughly inspected as in a Class 3 territory, and likewise, all material passing through the area from points west inside of the quarantine area.

One foreman was employed to aid the men when a new or difficult situation arose.

The following table shows the number of packages of fruit, vegetables and cut flowers certified, and the number of beetles removed from each class of produce at the inspection point:

Article	Number of packages	Number of beetles removed
Corn	218	5
Beans	771	
Peas	120	
Lettuce	245	
Vegetables with tops	934	
Miscellaneous vegetables	2089	12
Miscellaneous fruit	2421	
Bunches bananas	246	1
Boxes cut flowers	49	
Total	7,093	18

The number of bales of hay, straw and sphagnum moss certified for shipment from the regulated area of Stamford during the 1927 season, was as follows:

Hay	Straw	Moss	Total
15	5	1	21

The number of certificates issued on shipments of fruit, vegetables, cut flowers, and hay and straw, was as follows:

STAMFORD

Issued for	"A"	"B"	"C"	"F"	"H"	Total
Fruit and Vegetables		1102				1102
Cut flowers	4			47		51
Hay, straw, and moss	8					8
	12	1102		47		1161

The following table shows the number of vehicles bearing contraband articles intercepted at the Quarantine Line each month for the season:

Month	Darien	Noroton Heights	Springdale	Total
June 15 to 30	318	20	4	342
July 1 to 30	581	128	29	738
Aug. 1 to 30	549	103	28	680
Sept. 1 to 30	352	46	--	398
Oct. 1 to 15	32	—	—	32
Total	1832	297	61	2190

Nursery and Ornamental Stock

There are thirty-six Class 1 greenhouses and nurseries in the area; others have given up their classification and some establishments remain to be classified when they begin business in the spring. These classified establishments have a total of 310,500 square feet under glass and 1,187 acres of nursery stock.

During the past year 52,287 plants have been certified for shipments to points outside of the quarantined area and a total of 1,007 certificates have been issued for this purpose.

Altogether 308,400 pounds of sand, soil, peat and manure have been shipped to points outside of the quarantine area and 40 certificates were issued.

Summary

The average number of men employed at each different branch of the quarantine work, each month, during the year 1927, was as follows:

	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Scouting		30	30	12	0	0	0
Farm Produce	13	15	15	10	2	0	0
Nursery and Greenhouse		3	3	1	1	2	2
Administrative	2	2	2	2	2	2	2
Total number of men	15	50	50	25	5	4	4

The total number of each kind of certificates used on shipments of (A) nursery and ornamental stock, (B) sand, soil, peat, etc., (C) manure, (D) hay and straw, (E) fruit and vegetables, and

cut flowers, in the State of Connecticut from January 1 to December 31, 1927, was as follows:

Kind	Farm Produce	Cut Flowers	Hay and Straw	Nursery and Ornamental stock	Sand Soil	Peat etc.	Manure	Total
"A"		4	8	406	34	1	5	458
"B"	1102							1102
"C"								
"D"				84				84
"F"		47		483				530
"F" blanks				34				34
"H"								
Totals..	1102	51	8	1007	34	1	5	2208

The total number of articles certified and the number of beetles removed, in the State of Connecticut, Jan. 1 to Dec. 31, 1927, was as follows:

Total number of packages farm produce	7,044	Beetles removed	17
" " " boxes cut flowers......	49	" "	0
" " " bales hay and straw...	21	" "	0
" " " plants certified.......	52,287	" "	0
" pounds of sand, soil, etc.,.......	280,400	" "	0
" " " manure.............	28,000	" "	0
Total..........................	377,801	Total.............	17

During the year of 1927 there were three violations prosecuted: three complaints filed before the proper officials and ten violations on file, totaling sixteen in all.

Revision of State Quarantine

As the scouting by Federal men showed that the Japanese beetle occurs in Bridgeport, Darien, and New Canaan, it was necessary to revise the quarantine maps to include these areas. For the sake of safety it seemed best to include also some adjacent territory. Thus the Federal quarantine, effective November 1, 1927, included the southernmost two rows of towns in Fairfield County, comprising the coastal area two towns deep from the Housatonic River to the New York State line, and shown in Fig. 48.

After due notice a public hearing was held at the Station, November 12, 1927, and later a quarantine order was issued, revising the State quarantine to conform to the Federal quarantine. This revised State quarantine became effective December 1, 1927, and is as follows:

STATE OF CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
New Haven, Conn.

Quarantine Order No. 16
JAPANESE BEETLE QUARANTINE

The fact has been established by the Agricultural Experiment Station that the Japanese beetle, *Popillia japonica* Newman, has recently been found in the towns of Bridgeport, Darien, and New Canaan, and in order to prevent shipments of infested material to outside areas, it seems best to extend the quarantine regulations to the towns of Bridgeport, Darien, Easton, Fairfield, New Canaan, Norwalk, Shelton, Stratford, Trumbull,

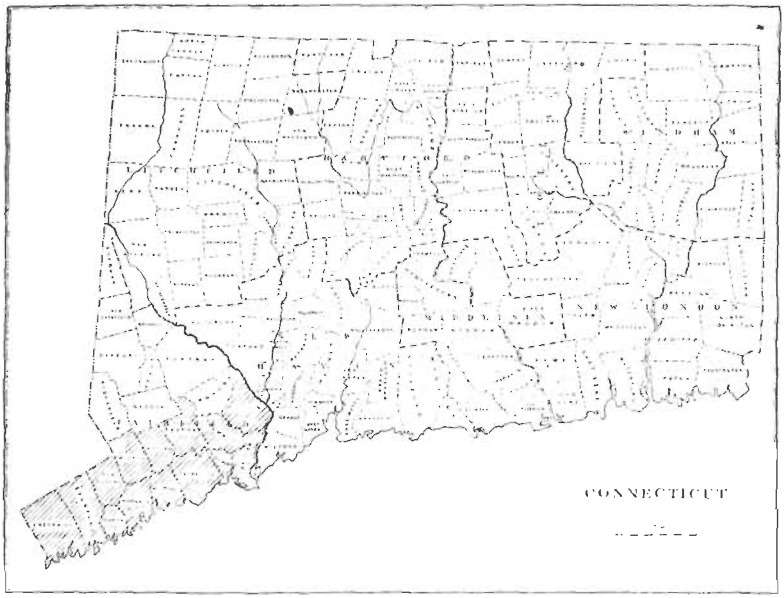


Fig. 48. Map of Connecticut showing area now under State and Federal quarantine on account of the Japanese beetle.

Weston, Westport, and Wilton, in conformity with Federal Quarantine action, effective November 1, 1927.

Now therefore, I, Director of the Connecticut Agricultural Experiment Station, pursuant to the provisions of Chapter 31, Public Acts of 1927, do hereby proclaim the towns of Bridgeport, Darien, Easton, Fairfield, Greenwich, New Canaan, Norwalk, Shelton, Stamford, Stratford, Trumbull, Weston, Westport, and Wilton, all in Fairfield County, to be under State quarantine, and that it shall be unlawful to move from these towns to other points within the State (1) farm, garden, and orchard products of all kinds; (2) grain and forage crops of all kinds; (3) nursery, ornamental, and greenhouse stock, and all other plants; and (4) sand, soil, earth, peat, compost, and manure, except under the conditions prescribed in the rules and regulations announced in Quarantine Order No. 12 (Revision effective

May 1, 1927) and published in Bulletin of Immediate Information No. 58, May 1, 1927.

This order shall take effect December 1, 1927, shall supersede previous orders concerning the Japanese beetle and shall be in force until further notice.

W. L. SLATE,
Director, Connecticut Agricultural Experiment Station.

Approved:
JOHN H. TRUMBULL,
Governor

REPORT OF ASIATIC BEETLE CONTROL AND QUARANTINE WORK IN 1927

W. E. BRITTON AND J. P. JOHNSON

During the winter of 1926-1927 a few experiments were started to find an insecticide that would act in conjunction with carbon disulphide for controlling the grub stage of the beetle. Others were begun with the view of determining the amount of arsenic and lead taken up by grass from soil which had been treated with arsenate of lead; also the effect of highly acid soils and alkaline soils upon the grub stage.

The headquarters in Westville were closed during the winter months, and the necessary work was directed from the Connecticut Agricultural Experiment Station. Headquarters were reopened about April 11, 1927.

GRUB SURVEY

There were five men employed in making the grub survey during the spring, beginning the work April 25, 1927. The same procedure was followed as was used during the season of 1926. This consisted in digging areas 12 inches by 18 inches, approximately 50 feet apart, in the front and rear yards of the homes; diggings were also made in apparently infested areas. The holes were dug to a depth of 9 to 21 inches, depending upon the soil temperature. The soil was thoroughly examined and, if necessary, sifted to determine the amount of infestation and the position of the grubs relative to the surface of the ground.

During the spring season there was a total of 552 diggings in Westville and 61 diggings in West Haven.

In the fall of 1927, diggings were made to determine the amount of infestation throughout the area to compute the relative values of the soil treatments for grubs which had been made during the preceding spring and the season of 1926; also to determine the increase, if any, of the infestation during the summer of 1927. There was a total of 787 diggings made in Westville, 75 diggings in West Haven, and 69 diggings in New Haven.

During the entire season 17 properties were surveyed for possible grub infestations, as requested by property holders in Westville, East Haven, New Haven, West Haven, and Hamden, outside of the quarantined area.

Soil Treatments

In planning soil treatment work for the spring, four tons of emulsion were purchased from the I. P. Thomas & Son Company, of Philadelphia, Pa. Treatments were begun May 18, and the work was completed June 22. Only two proportioning machines were in operation, due to the fact that only certain areas were to be treated, and a small force of men was employed. Fire hydrants supplied the water in all cases, giving a good pressure and enabling a maximum amount of work to be done quickly. In all, 163,247 gallons of water were used; 141,726 gallons in Westville and New Haven, and 21,521 gallons in West Haven. Rainy weather interfered to some extent, making it impossible to treat the soil for several days at a time.

Altogether 79 properties were treated in Westville, 30 in West Haven, and 2 in New Haven. Very little superficial burning of the grass occurred during the treatments, and this did not warrant any complaints, as the turf recovered in a few days.

Scouting

Scouting was conducted on a much larger scale for adult beetles in the summer of 1927 than during the preceding season. A total of three crews of five men each, one floating scout, and a foreman in general charge scouted around all premises, parks and certain fields in the area consisting of the shore towns from the Housatonic River to Indian Neck, Branford, including New Haven, and West Haven, and the inland towns of Ansonia, Derby, Shelton, Waterbury, North Haven, and Wallingford.

The procedure followed in scouting was to assign certain crews to certain localities, making them responsible for covering the areas thoroughly. The system followed by all the crews consisted in assigning two men to one street, operating on opposite sides and working down two streets, while the foreman of the crew scouted cross-streets and checked the men's work. The general scout foreman assigned the work to crew foremen and visited them every day.

Scouting began July 1 and ended September 9. The scouts were also looking for Japanese beetles in conjunction with the Asiatic beetles, as the plant hosts and procedure were approximately the same. The wages of the scouts were paid from the Federal Asiatic Beetle Appropriation.

Beetles were found at the following places outside the quarantined area:

Town	Locality	Date	No. Beetles
New Haven	272 Canner St.	July 15, 18	2
	116 Carmel St.	" 19	1
	116 Ellsworth Ave.	" 19	1
	316 Winthrop Ave.	" 20	1
	65 Carmel St.	" 21	2
			7
West Haven:	142 Main St.	" 22	1
	449 Second Ave.	" 23	1
	8 Washington Ave.	" 28	1
			3

The quarantine area was thoroughly scouted, and adults were found to be numerous on certain properties and scarce on others. The conditions under which the men worked were a repetition of those of the preceding year. The beetles were shy in attacking the flowers and foliage of plants and difficult to find. From all the reports received from the scouts there was not any evidence of commercial damage done to plants or lawns by the adults.

Quarantine Certification

The quarantine work was carried on by two men who made inspections and certified plants and soil products when calls demanded them. The following plants and soil products were certified:

Materials	No. Packages
Plant packages	2,827
Cut flowers, bunched	17
Plants (flower and vegetable)	4,066
Trees and shrubs	121
Cubic yards of sand and gravel	4,460
Total	11,491

Altogether, 2,891 certificates were issued in certifying material to be shipped out of the quarantined area.

Summary

	Westville	New Haven	West Haven	Totals
Diggings	1,339	69	136	1,544
Treatments	79	2	30	111
Gallons carbon disulphide	645	—	108	753
Gallons water	141,726	—	21,521	163,247
Number of beetles	2,032	17	3	2,052
Acreage treated	10.809+	—	1.36+	12.169+

There were 15 scouts, one general scout foreman, and one floating scout employed during the scouting season.

Altogether, 20 towns were scouted during the summer season. In all, 17 special surveys were made during the year 1927.

A total of 11,491 articles, consisting of plants and soil products, was certified for shipment outside of the quarantine area, using 2,891 certificates.

The results of the last two years' work are somewhat confusing, and it is a difficult matter to give definite figures. However, the condition of the turf in Westville indicates a grub infestation and injury similar to that of the spring of 1926; that is, the existing conditions are no worse at the present time than two years ago. The grub infestations are, however, more widespread and general.

An infestation found at 437 Savin Avenue, West Haven, on May 17, 1926 was treated in the spring and fall of the same year. In the past year diggings were made and summer scouting done. Nothing was found, thus indicating an excellent control or extermination of the beetle at that place.

On October 4, 1926, an infestation of some extent was found on Washington Manor Avenue. This infestation was treated in the fall of 1926 and the spring of 1927. Summer scouting was performed and diggings were made in the fall, yielding three adults and three larvae. When the infestation was found it covered about 25 properties, and the extremely small number of grubs found after treatments certainly indicated a very good control.

MOSQUITO CONTROL WORK IN CONNECTICUT

Season of 1927

R. C. Botsford

In practical control work the 30 or more species of mosquitoes found in Connecticut are placed in two groups: those breeding in fresh water, and those breeding in salt or brackish water. The general methods employed for the control of these two groups are the same, but the chief practical difference is in their habits of flying and biting. The fresh water breeding mosquitoes fly short distances and bite only in the early morning or evening, whereas the salt water breeding mosquitoes bite at any time during the twenty-four hours of the day, breed in greater numbers, and fly long distances. The salt water breeding mosquitoes are, therefore, the greater nuisance, especially at our shore resorts, where they affect a large percentage of the State's population.

It is the policy of this Station, therefore, to direct its attention to ditching the salt marshes and maintaining the work according to statute.

Surveys and estimates of the cost of treating both salt marsh and fresh water swamp areas are made from time to time throughout the year upon request, without charge.

Present State funds are inadequate to perform the work prescribed by the General Statutes and demanded by our citizens. The State appropriation is only $7,500 a year. From this amount

must be paid the salary and traveling expenses of the deputy in charge, labor to patrol and clean ditches on more than 5,000 acres of salt marsh, and major repairs on dikes, tide gates, and culverts. In spite of every possible economy in the expenditure of the funds, much important repair work must be abandoned.

A deficiency appropriation of $3,000 was granted this year but was restricted in its use to major repairs. It was received too late to be expended before the legal time limit on the use of such funds had expired, and a part was returned to the State treasury.

Due to the unusually wet season, a maximum amount of both fresh water and salt water mosquito breeding occurred in untreated areas. However, in Westport, Clinton, and Westbrook, where ditching of the salt marshes has been under way, a striking reduction of mosquitoes was reported. Ditched areas which required overhauling bred mosquitoes heavily throughout July and August.

Funds for regular maintenance work were exhausted about January first, and no patrol work was started until July first, when the new appropriation became available. During April, May, and June, a few men were retained by funds furnished for special work by the State Park and Forest Commission, the towns of Stamford and Fairfield, and Mr. W. A. Bryan of Branford.

The following table gives the status of the salt marsh areas of Connecticut:

STATUS OF CONNECTICUT SALT MARSH AREAS, 1927

Town	Salt Marsh Areas	Salt Marsh Ditched	Maintained by State	Total Cost of Ditching	Labor, Cost Maintenance, 1927	Labor, Cost to Complete Ditching
Greenwich	200	200	None	....	....	....
Stamford	300	300	200	$3,245.80	$458.53*	....
Darien	300	300	None	3,800.00	....	....
Norwalk	600	600	None	7,500.00	....	....
Westport	400	400	None	5,913.82	....	....
Fairfield	1,200	1,200	1,200	8,400.00	3,390.87**	....
Bridgeport	173	....	....	....	....	$3,000.00
Stratford	1,315	....	....	....	....	20,000.00
Milford	630	....	....	....	....	9,500.00
West Haven	463	222	222	Ditched with New Haven	208.25†	3,500.00
New Haven	750	750	675	12,000.00	....	750.00
Hamden, No. Haven	2,042	....	....	....	....	30,000.00
East Haven	482	150	50	Ditched with New Haven	6.40	6,500.00
Branford	895	578	578	....	2,360.70‡	4,800.00
Guilford	1,085	1,085	1,085	20,000.00	1,940.34	....
Madison	1,005	1,005	1,005	....	3,405.57‡‡	....
Clinton	785	677	None	10,000.00	....	2,000.00
Westbrook	500	375	None	6,575.93	....	1,000.00

* City of Stamford, $339.
** Town of Fairfield, $2,955.45.
† Town of West Haven, $125.
‡ Indian Neck Association, $200.
‡‡ State Park and Forest Commission, $2,800.

STATUS OF CONNECTICUT SALT MARSH AREAS, 1927—*Cont.*

Town	Salt Marsh Areas	Salt Marsh Ditched	Maintained by State	Total Cost of Ditching	Labor, Cost Maintenance, 1927	Labor, Cost to Complete Ditching
Old Saybrook	1,373	100	None	....	....	20,000.0
Lyme	493	....	....	....	....	7,500.0
Old Lyme	1,393	....	....	....	....	21,000.0
East Lyme	424	....	....	....	....	6,500.0
Waterford	204	....	....	....	....	3,500.0
New London	34	....	....	....	....	500.0
Groton	304	50	50	1,000.00	15.00	4,000.0
Stonington	555	....	....	....	....	8,500.0
	18,005	7,992	5,065	$78,435.55	$11,785.66	$152,550.0

It was the practice of this Station formerly to assign some local man in each town for patrol and maintenance of the salt marshes of the town. These areas are usually small and widely separated, and in the maintenance work considerable time is lost in traveling from one point to another. Those men do not own autos, and in many cases trolleys are not available, and often a man is forced to walk several miles from his home to the job and back, sometimes consuming as much as one and a half to two hours twice a day in this manner. There is also a certain element of danger to a man in allowing him to work alone on some marshes.

After a trial of two seasons, it was found more satisfactory and efficient to hire a working foreman with an auto and pay him mileage for the use of his auto to transport the men and tools from place to place, assigning to him a group of towns or salt marsh areas.

To maintain properly the state-accepted areas, three such units will be necessary after this biennium.

Below is a preliminary schedule of the minimum budget for mosquito control work for the next biennium, July 1, 1929 to July 1, 1931:

			UNIT NO. 1	
Stamford	300 acres		Working foreman	$1365.
Westport*	400	"	1 laborer 36 weeks at $24	864.
Fairfield	1,200	"		
	1,900	"		
			UNIT NO. 2	
West Haven	463	"	Working foreman	$1365.
New Haven	750		3 laborers 36 weeks at $24	2592.
East Haven	482	"		
Branford	895	"		
Groton	50	"		
	2,640	"		

*To be added July 1, 1929

			Unit No. 3	
Guilford	1,085	acres	Working foreman	$1365.
Madison	1,005	"	2 laborers 36 weeks at $24	1728.
Clinton*	785	"		
Westbrook*	500	"	Total for three units	$9279.
	2375	"		

*To be added July 1, 1929

SUMMARY

Labor	$9,279.
Supervision, etc.	3,000.
Contingent	221.
Annual	$12,500.
Biennial period	$25,000.

The Work by Towns

NEW HAVEN

New Haven, East Haven, Branford, and Guilford were patrolled as one unit as in 1926. Very little ditch recutting was required in New Haven this year, as the salt marsh areas were found in very good condition. A new main ditch was dug at Fort Hale to facilitate drainage north of Fort Hale Road.

The New Haven Chamber of Commerce committees have been active throughout the season on a well-developed program to eliminate mosquito breeding in the salt marshes of towns surrounding New Haven.

This Station made a preliminary survey of this situation, which was published in the Report of this Station for 1926.

Substantial sums for treating these salt marsh breeding areas have been appropriated by New Haven, East Haven, and Branford. The towns of Hamden and North Haven have not as yet appropriated funds for this, although individuals in the five towns have contributed generously.

WEST HAVEN

Dr. Charles D. Phelps assumed entire charge of anti-mosquito work this season. The State-accepted salt marsh areas were kept free from breeding under his supervision, but mosquitoes emerged in great numbers from untreated fresh water areas.

EAST HAVEN

The salt marsh areas under State care were patrolled and ditches cleaned where necessary to facilitate drainage. No mosquito breeding was found on these areas.

Salt marsh mosquitoes which developed in untreated areas and were so plentiful early in the summer disappeared in July and August, and fresh water swamp mosquitoes took their place in even greater numbers.

BRANFORD

Salt marshes east of the Branford River were well patrolled and ditches repaired where necessary.

A new concrete tide gate sill was installed at Hubbard's Bridge on the Branford River. Funds for this were made available through a deficiency appropriation by the General Assembly. New gates will be installed when the necessary funds are received.

GUILFORD

The recutting of ditches in Guilford has progressed as rapidly as funds would allow. The salt marsh areas between West River and East River south of the railroad were completed this fall, but must be patrolled thoroughly in order to eliminate the smaller breeding places which may yet exist.

A serious leak under the tide gate sill at Great Harbor was repaired this season at considerable expense. The property owners east of the tide gate failed in their promise to repair the weak dike there. As a result a storm broke through and destroyed a large section of the dike and flooded the marsh.

The marsh at Shell Beach was improved by reditching and lowering a culvert.

MADISON

The State Park and Forest Commission reditched practically all of the salt marsh areas at Hammonasset Park under the supervision of this Station. This work will eliminate the most prolific breeding places in the town.

The remaining salt marsh areas were patrolled as usual and the culverts and outlets at the beaches kept open. Some culverts were damaged this winter by storms.

CLINTON

The Clinton problem remains unchanged. One hundred acres of salt marsh are unditched, and the areas ditched cannot be approved by the State on account of faulty ditching. Some funds are available to correct the faulty ditches, and this may be done next season. A new outlet through Grove Beach may be necessary to lower the water level in the rear of Grove Beach and so make it possible to properly maintain the work.

WESTBROOK

Funds appropriated for ditching salt marshes of this town were exhausted before the work was completed. This was due to the fact that the inland salt marsh areas which were left to the last were in extremely soft condition and required double ditching. The work will be completed next spring on funds already appropriated by the town.

GROTON

This small area was patrolled as usual. Spur ditches were placed where necessary and main outlets were deepened.

FAIRFIELD

The town of Fairfield has always been set up as an example of a good mosquito control work and co-operation in furnishing funds for the work. The salt marsh areas were patrolled as usual, the town furnishing the labor. The draining of fresh water swamps and stagnant pools progressed steadily with town and voluntary labor. Supervision of both salt water and fresh water work was furnished by the State.

WESTPORT

Ditching of the salt marshes of the town of Westport was completed early in the season. The total footage of 10 x 24 ditches cut with special tools was 163,529 feet. A great deal of day labor was required to complete the ditching where rocks and ledges interfered. The extra expense of this work ran the cost of the work somewhat over our original estimate.

The work was approved on October 1, 1927 and will be maintained under State supervision when funds are provided.

STAMFORD

The Stamford areas were patrolled and kept in repair. The city of Stamford paid some of the labor cost. New roadways and hydraulic filling interfered somewhat with the work. The city continued its treatment of fresh water swamps.

MISCELLANEOUS INSECT NOTES

Severe Injury to Fruit by the Green Apple Aphid.—It has been mentioned on page 198 of this Report that the green apple aphid, *Aphis pomi* De Geer, was so very abundant in 1927 that it attacked and injured the young fruit in a manner similar to the rosy apple aphid, *Anuraphis roseus* Baker. Young apples injured by the green apple aphid are shown on Plate XXVIII, b.

Brown Scale on Arborvitae.—While inspecting nurseries in Hartford, August 13, 1927, Mr. Zappe collected material of a brown scale which was rather prominent on the twigs of arborvitae. Some of this material was submitted to Mr. Harold Morrison of the U. S. Bureau of Entomology and identified as *Lecanium fletcheri* Ckll. Some entomologists consider this species synonymous with the European fruit lecanium, *Lecanium corni* Bouché, but until further study has settled this point, it is perhaps best to allow the former name to stand. Probably this insect can be kept under control by spraying with nicotine solution and soap.

Abundance of the Mealy Plum Aphid.—The mealy plum aphid, *Hyalopterus arundinis* Fabr., occurs on European plum, *Prunus domestica* Linn., from which it migrates to reed grass, *Arundinaria* sp. This aphid is usually clustered on the under side of plum leaves, often covering the leaves, and the wax secretion gives a peculiar mealy appearance of bluish tint. In 1927 this insect was unusually common. It was received from New Haven on June 17, and was abundant at the Station Farm at Mount Carmel. Plate XXVIII, a, shows some infested leaves where all the aphids had been killed by spraying with a pyrethrum-soap emulsion.

Watch for 17-year Locust in 1928.—In 1911, Brood No. 11, of the 17-year locust or periodical cicada, *Tibicina septendecim* Linn., appeared in Connecticut, especially on the trap rock ridges of New Haven and Middlesex Counties and the southern portion of Hartford County. When abundant the females cause considerable injury to fruit trees by splintering the twigs in laying their eggs. This brood No. 11 is due to appear again in Connecticut in 1928. The insects may be expected to commence emerging about the middle of May and continue for about a month. In 1911, they were the most abundant about the middle of June. The Entomologist will welcome any information regarding the occurrence of this curious insect the coming season.

Abundance of the Raspberry Sawfly.—The raspberry sawfly, *Monophadnoides rubi* Harris, was present in considerable numbers in raspberry plantations. Specimens were received from West Haven, June 16, and Dr. Friend visited a garden in Hamden on June 15 where the raspberry plants had been stripped of their leaves by the small spiny larvae. An illustration of one of these larvae is shown on Plate XXIX, a, and more complete information may be found in the Report of this Station for 1918, page 329. Early spraying, or dusting the foliage with lead arsenate or fresh hellebore will be found effective in protecting the plants from defoliation. Lead arsenate should not be applied late in the season when the fruit is nearly ready to harvest.

The Poplar and Willow Curculio.—On June 7, some bark of the pussy willow was brought to the Station, containing several grubs of the poplar and willow curculio, *Cryptorhynchus lapathi* Linn. The owner had in his yard a small willow tree which had been attacked and nearly killed by the grubs. Many willows of this variety growing wild are killed in the same manner, and apparently there is no practical method of saving them. A section of the bark and some of the grubs are shown on Plate XXIX, c. These grubs were almost grown, and there is only one generation each year. The adult is a snout beetle which emerges in late July or August. The eggs are soon laid and hatch, and the larvae pass the winter in the galleries under the bark.

The Blackberry Psyllid.—The blackberry psyllid, *Trioza tripunctata* Fitch, feeds upon the native blackberry and sometimes attacks the cultivated varieties. The adults hibernate and appear on the blackberry plants soon after growth starts in spring. Eggs are laid in the soft pubescence of the unfolding leaves and young canes. The nymphs are gregarious, feed on the under side of the leaf, and are covered by curved wax filaments, as shown on Plate XXXI, a. Both nymphs and adults suck the sap from the plant and cause it to grow in a distorted manner; also shown on Plate XXXI, b. Though little study has been given this insect, and control measures have not been worked out, it is probable that spraying with nicotine solution and soap will prove effective.

A New Mosquito Ditching Spade.—In the history of cutting ditches for mosquito elimination several spades have been devised and used. So far each has developed some disadvantage when put to the practical test of cutting several hundred feet of ditches in the salt marsh. The spade, shown on Plate XXXII, has recently been devised by Mr. R. C. Botsford of this Station. It is lighter than some of the others, has two wood handles joined at the top by a crosspiece, and is convenient to use. It has a blade 36 inches long, with handles 52 inches long and a total length of 78 inches. The blade as shown extends 25 inches below the fulcrum, but the fulcrum may be raised to cut a deeper ditch. This spade cuts a ditch 10 inches wide and has a long slot in the center of the blade for suction relief. Wings project forward for cutting the sides of the ditches. This spade has been patented by Mr. Botsford.

The Greenhouse or Celery Leaf-Tyer.—The greenhouse leaf-tyer, *Phlyctaenia ferrugalis* Hubn., also called the celery leaf-tyer, was present in the Station greenhouses and caused considerable injury to alfalfa and other plants being grown under experiment. The larvae feed on the under side of the leaves, and the food plants include nearly all of the common vegetables, many weeds, and a large number of ornamental herbaceous plants growing both under glass and out of doors. There are said to be four generations each year in the open but under glass there may be seven. When disturbed, the caterpillars wriggle back and forth. They are from half to three-fourths of an inch long, translucent greenish yellow, with a narrow dark green median stripe. A larva feeding upon a geranium leaf is shown on Plate XXVII, a. Spraying with lead arsenate is the remedy. Small potted plants may be dipped into the poison liquid. It is necessary to coat the under side of the leaves with poison because the caterpillars generally feed there. Such plants as celery and lettuce must be protected in some other manner.

Cottony Maple-Leaf Scale on Dogwood.—During the summer of 1926, cottony scales were rather abundant on the under side of the leaves of two trees of flowering dogwood, *Cornus*

florida, growing on the premises of the Entomologist in New Haven. Specimens were collected on October 8, 1926, and on June 27, 1927, and submitted to Mr. Harold Morrison of the Bureau of Entomology at Washington. It was impossible to identify the species from the material collected in October, but from the lot collected in June Mr. Morrison expressed his opinion that the insect is *Pulvinaria acericola* Walsh & Riley, though in case of a critical revision of the genus, it may be necessary to give it another name. The mature females and their ovisacs are shown on Plate XXX, a. This insect passes the winter in a partially mature condition on the twigs. In May the females migrate to the leaves and deposit their eggs in the large white masses of wax of the ovisac. The young hatch in June and feed upon the leaves, but early migrate to the twigs for the winter. The cottony maple scale, *Pulvinaria vitis* Linn., matures and deposits its eggs upon the twigs and branches.

INDEX

abbot sphinx, 207
Acronycta rumicis, 222
Adelges abietis, 207, 211, 214
  pinicorticis, 207
  strobilobius, 207
Agrilus viridis var. *fagi*, 222
Alsophila pometaria, 200, 204
Anastatus bifasciatus, 243
Ancylis comptana, 208, 269
Anomala orientalis, 197, 209, 288-291
Anuraphis roseus, 198, 296
Aphids and weather conditions, 271-276
Aphis pomi, 198, 276, 296
Apiary inspection, 223-230
Aporia crataegi, 223
Apple and thorn skeletonizer, 200
  aphid, green, 198, 296
    rosy, 198, 296
    woolly, 199
  bucculatrix, 200
  leafhopper, 199
  maggot, 201
  spraying and dusting, 256-261
Arundinaria sp. 297
Asiatic beetle, 197, 209
  control work, 288-291
Asparagus beetles, 202
Aspidiotus perniciosus, 199
Asterolecanium variolosum, 206
Bacillus larvae, 225
  pluton, 225
Beech woolly aphid, 207
Birch leaf miner, imported, 197, 205
  skeletonizer, 197, 205
Blackberry psyllid, 298
Blister beetle, margined, 203
Boxwood leaf miner, 208
Brachyrhinus sulcatus, 208
Bristle tail, 209
Bucculatrix canadensisella, 197, 205
  pomifoliella, 200
Bud moth, 200
Cabbage maggot, 203
  worm, green, 203
Calophasia lunula, 223
Calosoma scrutator, 200, 262
Cankerworms in New London County, 261-262
  fall, 200, 204
Carpocapsa pomonella, 200
Carrot rust fly, 203, 278-279
Catalpa bungei, 212
Celery leaf-tyer, 298
Ceratophyllus gallinae, 209, 279-280
Chalepus dorsalis, 206
Cherry aphid, 199
Chionaspis pinifoliae, 207
Cicada, periodical, 297
Clethra alnifolia, 212
Codling moth, 200
Coleophora limosipennella, 205
Conotrachelus nenuphar, 197, 200
Contarinia pyrivora, 201
Convention of entomological workers, 209
Corn borer, European, control work, 246-256
    quarantine 252-256
  ear worm, 203
  maggot, seed—, 203
  seed, inspection, 221
Cornus florida, 298
Crepidodera helxines, 212
Crioceris asparagi, 202
  12-punctata, 202
Cryptorhynchus lapathi, 206, 297
Cucumber beetle, striped, 202
Currant aphid, 199
Cutworms, 201
  variegated, 201
Cyclamen mite, 208
Datana ministra, 200
Derris, 277
Diabrotica vittata, 202
Dichomeris marginellus, 207
Diprion simile, 205, 212
Elm case bearer, European, 205
  leaf beetle, 205
  scale, 206
Emphytus cinctus, 223
Empoa rosea, 199
Empoasca mali, 199
Ennomos subsignarius, 200
Epicauta marginata, 203
Eriocampoides limacina, 201
Eriophyes pyri, 199
Eriosoma lanigerum, 199
Eulia velutinana, 200
Euproctis chrysorrhoea, 223
Feltia venerabilis, 202
Fenusa pumila, 197, 205
Field slug, gray, 203
Foul brood, American, 225-226, 230
  European, 225, 230
Fruit insects, 198-201
  scale, European, 201
  worm, green, 200
Galerucella xanthomelaena, 205
Garden flea hopper, 203
Gillettea cooleyi, 207, 211, 213, 214
  var. *coweni*, 207
Gipsy moth, 201
  parasites, 243-244
  quarantine, 246
  work, 231-246

Gossyparia spuria, 206
Grain moth, Angoumois, 269
Greenhouse leaf-tyer, 298
Heliothis obsoleta, 203
Hemerocampa leucostigma, 200, 205
Hemerophila pariana, 200
Hen flea, European, 209, 279-280
Hyalopterus arundinis, 199, 297
Hylemyia brassicae, 203
cilicrura, 203
Hylobius pales, 206
Hyphantria cunea, 200, 204
Illinoia pisi, 204
Impatiens Balsamina, 208
Insecticide substitutes for nicotine sulphate 277-278
Inspection, Apiary, 223-230
Imported nursery stock, 221-223
Nursery, 210-219
Raspberry plantations, 219
Iris borer, 208
Janus abbreviatus, 212
Japanese beetle, 201
control work, 281-288
quarantine, 286-288
Juniper webworm, 207
Kalmia latifolia, 220
Kermes, sp., 206
Larch woolly aphid, 207
Laspeyresia molesta, 197, 200, 263-271
Laurel inspection, 220
Leaf roller, red-banded, 200
Lecanium corni, 201, 206, 296
European, 206
fletcheri, 296
nigrofasciatum, 206
Leopard moth, 205
Leptinotarsa decemlineata, 202
Leptobyrsa rhododendri, 208
Limax agrestis, 203
Lina scripta, 212
Linden moth, snow-white, 200
Locust leaf miner, 206
17-year, 297
Lycophotia margaritosa saucia, 201
Macrocentrus ancylivora, 268
Macronoctua onusta, 208
Macrosiphum solanifolii, 204
Malacosoma americana, 200
Mamestra picta, 203
Maple leaf bladder gall, 207
scale, cottony, 298
scale, cottony, 299
Melittia satyriniformis, 203
Monarthropalpus buxi, 208
Monophadnoides rubi, 201, 297
Mosquito control work, 291-296
Myzus cerasi, 199
persicae, 204
ribis, 199
Narcissus inspections, 220
Neodiprion pinetum, 205
Nicotine sulphate substitutes, 277-278
Notolophus antiqua, 223
Nursery dealers, 220
firms in Connecticut, 215-219
inspection, 210-219
pests, 211-214
stock, imported, inspection, 221-223
Oak gall scales, 206
scale, pit-making, 206
Onion maggot, 204
thrips, 204
Ornamentals, Insects attacking, 207-209
Pales weevil, 206
Papaipema nebris, 208
nitela, 203
Papilio podalirius, 223
Paratetranychus pilosus, 199
ununguis, 207
Parharmonia pini, 205
Pea aphid, 204
Peach moth, Oriental, 197, 200, 263-271
Pear leaf blister mite, 199
midge, 201
psylla, 199
slug or sawfly, 201
Phorbia ceparum, 204
Phyllaphis fagi, 207
Phyllocoptes quadripes, 207
Phlyctaenia ferrugalis, 298
Physokermes piceae, 206
Pine bark aphid, 207
leaf scale, 207
sawflies, 205
shoot moth, European, 205
weevil, white, 205
Pissodes strobi, 205
Pitch-mass borer, 205
Plagiodera versicolora, 206, 212
Plum aphid, mealy, 199, 278, 297
curculio, 197, 200
Pontia rapae, 203
Popillia japonica, 201, 281-288
Poplar curculio, 206, 297
Porthetria dispar, 201
Potato aphid, 204
beetle, Colorado, 202
Prunus domestica, 297
Psila rosae, 203, 278-279
Psylla pyricola, 199
Pteronidea ribesi, 196
Publications of Department, 194
Pulvinaria acericola, 299
vitis, 299
Pyrausta nubilalis, 246-256
Pyrethrum extracts, 277
Quercus robur, 206

Raspberry inspection, 219
  sawfly, 201, 297
Red-humped caterpillar, 200
Red mite, European, 199
  spider, 208
Rhagoletis pomonella, 201
Rhododendron lace bug, 208
Rhus canadensis, 213
Rhyacionia buoliana, 205
Rose leafhopper, 199
Sacbrood, 226, 227, 230
San José scale, 199
Schizura concinna, 200
Silver fish, 209
Sitona sp., 223
Sitotroga cerealella, 269
Sminthurus hortensis, 203
Spade, Mosquito ditching, 298
Sphecodina abbotii, 207
Spinach aphid, 204
Spraying and dusting apples, 256-261
Spruce bud scale, 206
  gall aphid, 207
    blue, 207
  mite, 207
Squash borer, 203
Stalk borer, 203, 208
Strawberry leaf roller, 208, 269
Tarsonemus pallidus, 208
Tent caterpillar, Eastern, 200
Terrapin scale, 206
Tetralopha robustella, 206
Tetranychus bimaculatus, 208
Thermobia domestica, 209
Thrips tabaci, 204
Tibicina septendecim, 297
Tmetocera ocellana, 200
Toumeyella liriodendri, 206
Tree insects, shade and forest, 204-207
Trichogramma minuta, 268, 269
Trioza tripunctata, 298
Tulip tree scale, 206
Tussock moth, white-marked, 200, 205
Vanessa sp., 223
Vegetable insects, 201-204
Vine weevil, black, 208
Webworm, fall, 200, 204
Willow curculio, 206, 297
  leaf beetle, imported, 206
Xylina antennata, 200
Yellow-necked caterpillar, 200
Zebra caterpillar, 203
Zeuzera pyrina, 205

1. View at Woodbridge infestation where 416 egg-masses were found and destroyed.

Seymour infestation where egg-masses were found and destroyed.

GIPSY MOTH WORK

PLATE XXII.

a. Trees stripped by gipsy moth caterpillars near Fall River, Mass. Photo July 12, 1927.

b. View of woodland near Fall River, Mass., partially defoliated by caterpillars. Photo July 18, 1927.

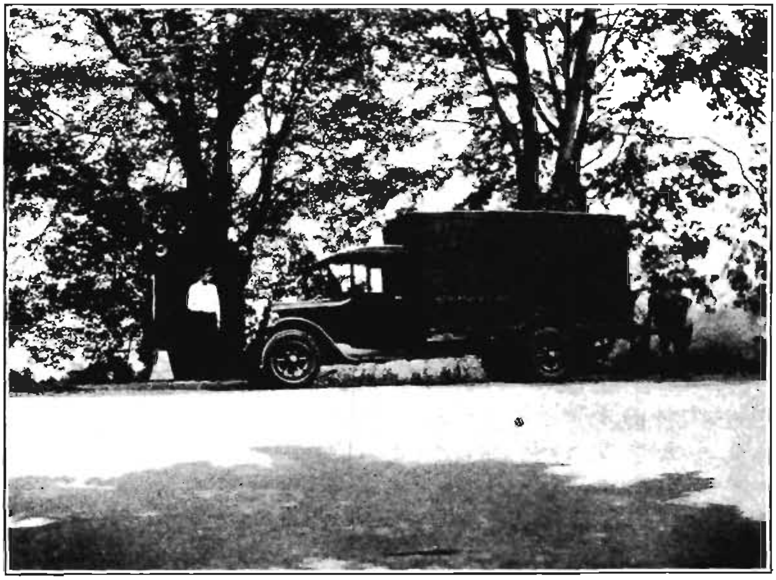
GIPSY MOTH WORK

a. Japanese beetle quarantine sign on Post Road, Darien.

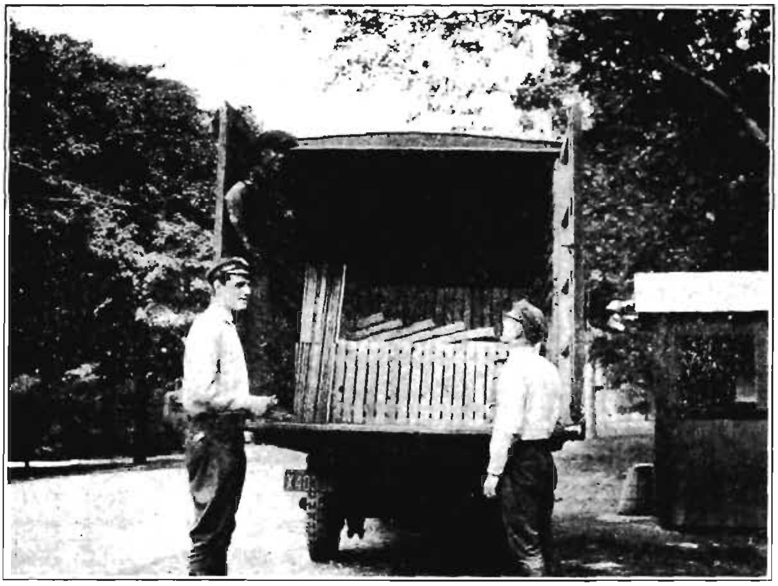
b. Inspection booth, Japanese beetle quarantine, Darien.

JAPANESE BEETLE QUARANTINE

PLATE XXIV.



a Truck stopped by inspectors, Post Road, Darien.



b. Covered truck opened for inspection, Post Road, Darien.

JAPANESE BEETLE QUARANTINE

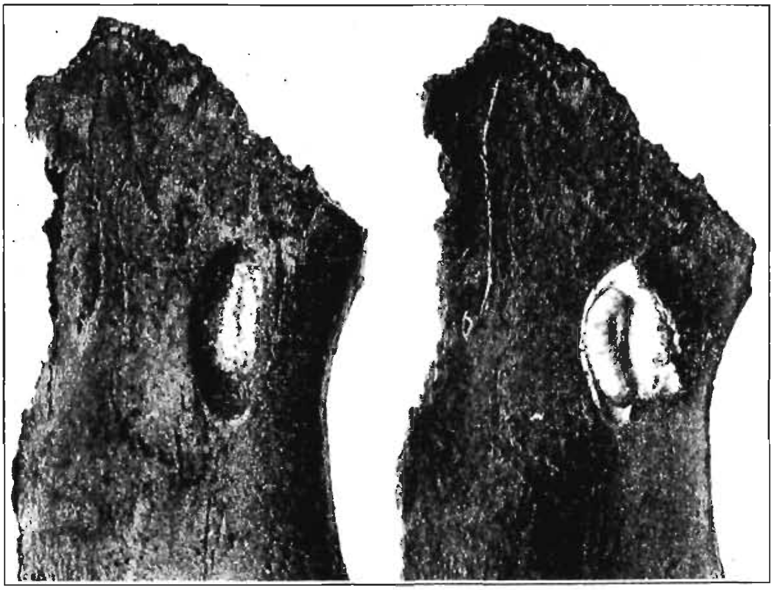
PLATE XXV.

a. Trees partially defoliated by cankerworms, East Lyme.

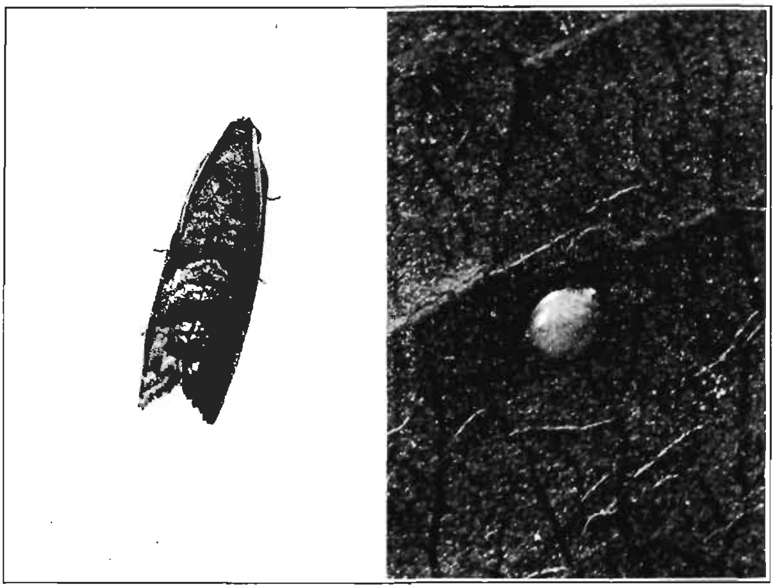
b. Cankerworms crawling on side of cottage, East Lyme.

CANKERWORMS

PLATE XXVI.

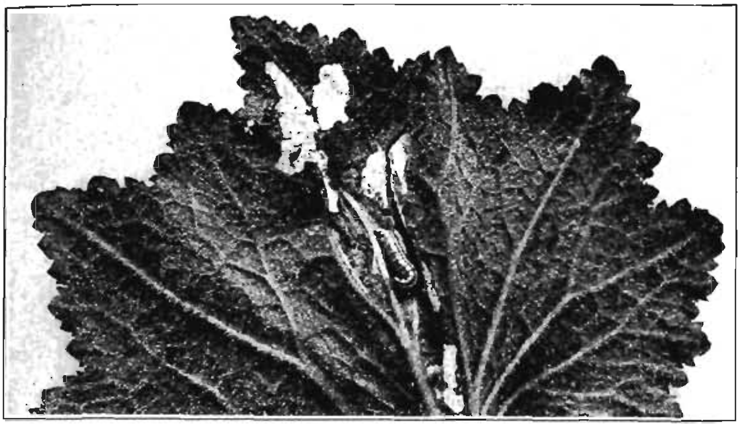


a. Left, cocoon under bark; right, cocoon opened to show insect. Twice enlarged.

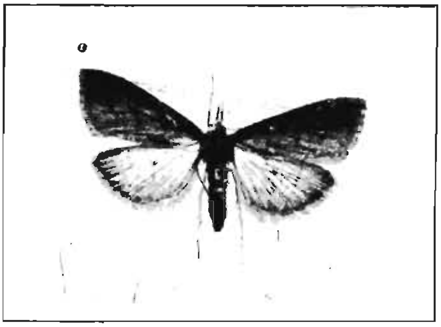


b. Left, adult moth, enlarged six times; right, egg, enlarged eighteen times.

ORIENTAL PEACH MOTH



a. Larva of greenhouse leaf-tyer feeding on geranium. Natural size.

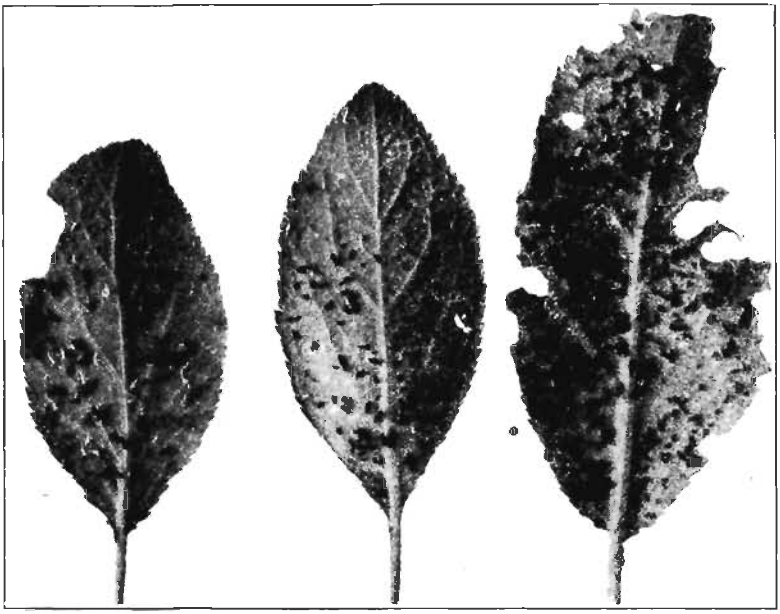


b. Adult of the greenhouse leaf-tyer
Twice natural size.

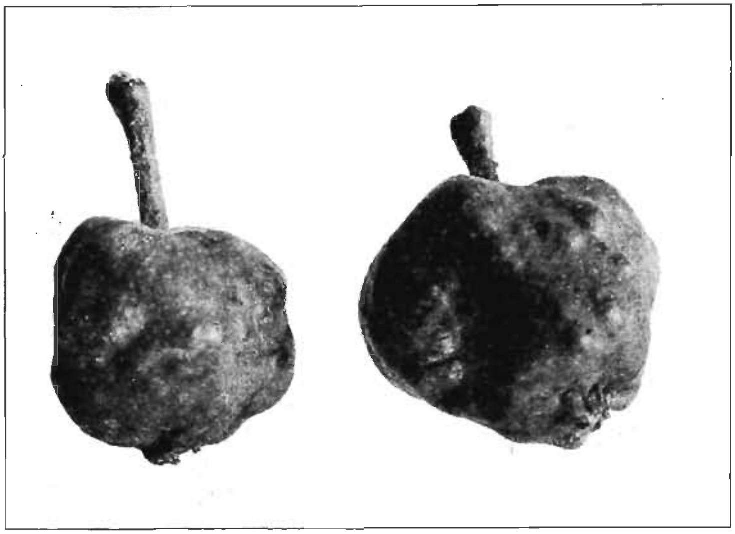
c. View in peach orchard showing bait pail to catch Oriental peach moths.

GREENHOUSE LEAF-TYER AND ORIENTAL PEACH MOTH

PLATE XXVIII.



a. Mealy plum aphid on European plum; killed by spray of Pyrethrum soap. Natural size.

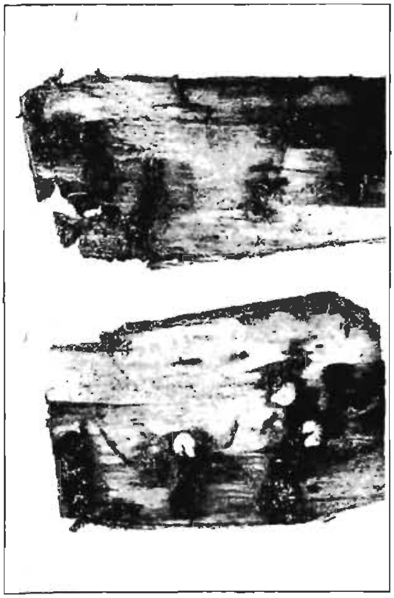


b. Apples injured by green apple aphid.

APHIDS

a. Raspberry sawfly: larva and injury to leaf. Twice natural size.

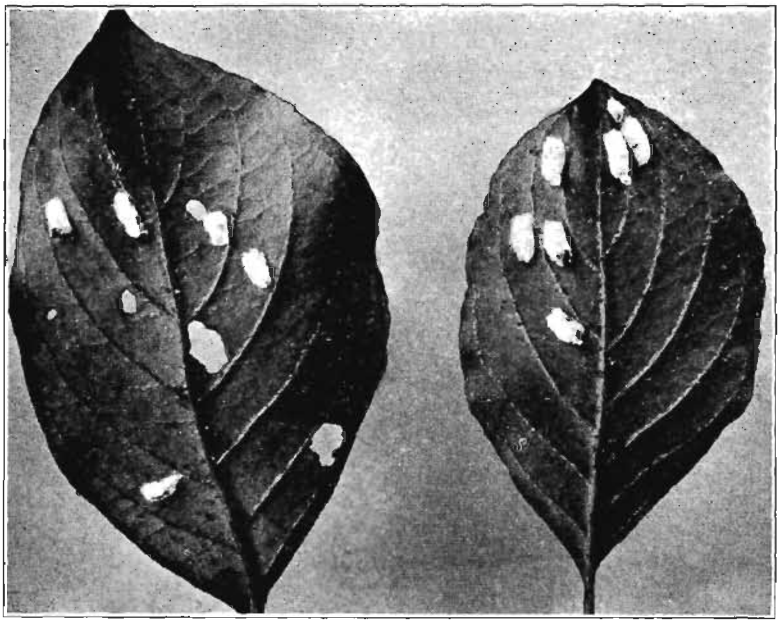
b. European hen flea. Enlarged about 25 times.



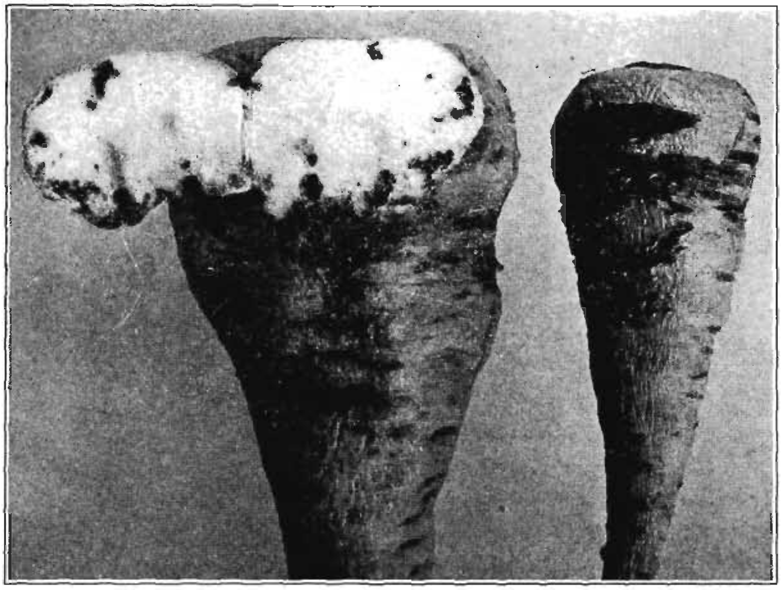
c. Grubs of poplar and willow curculio. Natural size.

RASPBERRY SAWFLY; EUROPEAN HEN FLEA; POPLAR AND WILLOW CURCULIO

PLATE XXX.

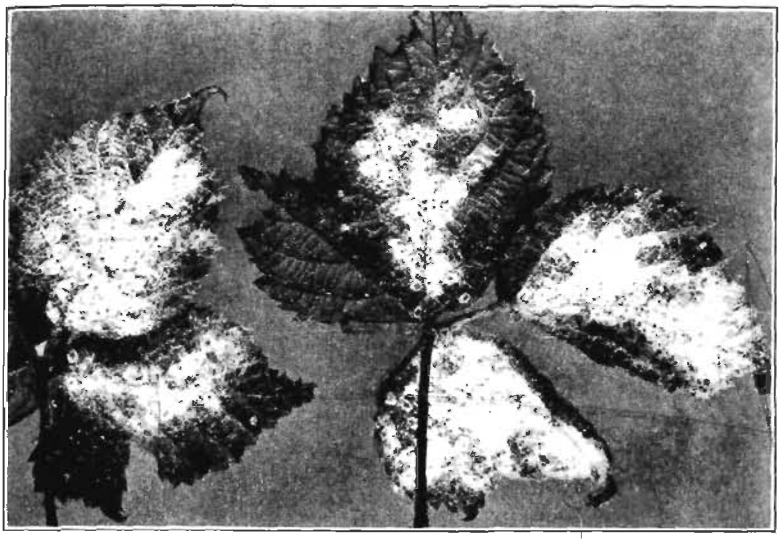


a. Cottony maple-leaf scale on leaves of flowering dogwood. Natural size.

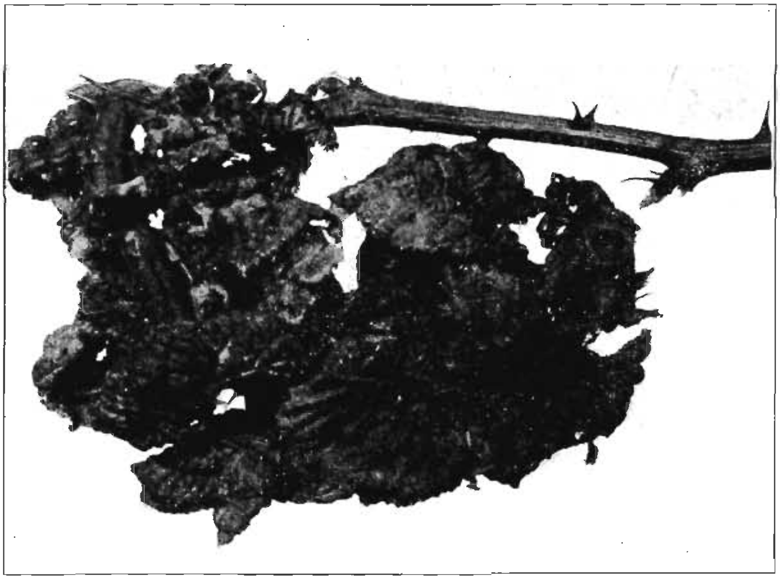


b. Tunnels of carrot rust fly in parsnip. Slightly reduced.

COTTONY MAPLE-LEAF SCALE AND CARROT RUST FLY

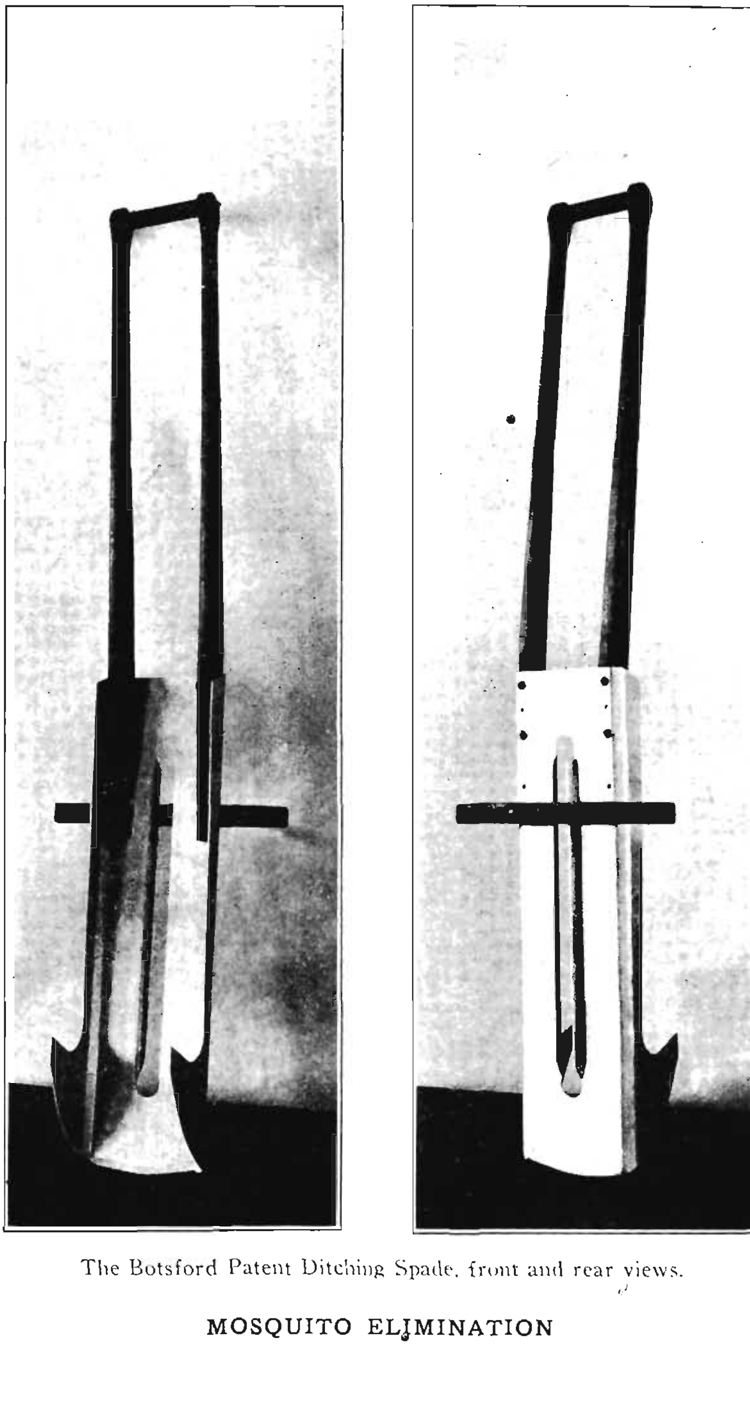


a. Nymphs on under side of leaves. Slightly reduced.



b. Gall or distorted leaves and stem, caused by nymphs and adults. Slightly enlarged.

BLACKBERRY PSYLLID



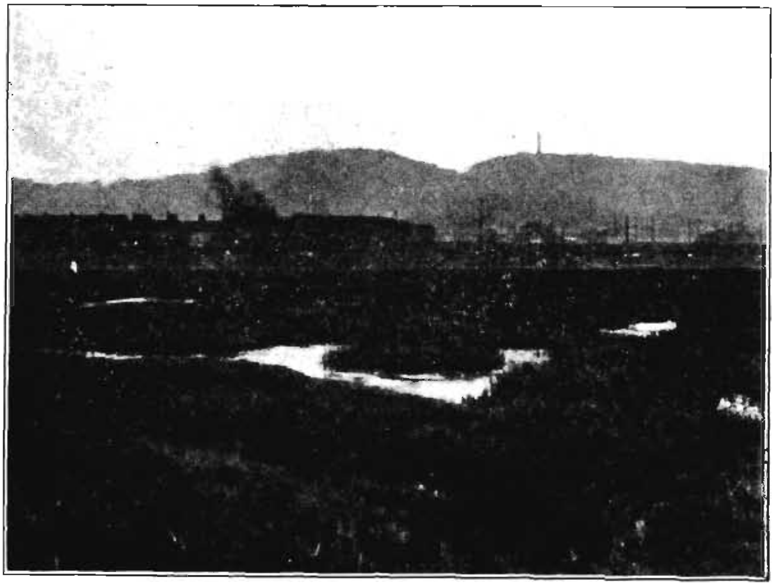
The Botsford Patent Ditching Spade, front and rear views.

View of a small pool between ditches which dried up completely after the ditches were cut. Clinton.

View in Clinton, showing former mosquito breeding area which, since ditching, is wholly dry.

PLATE XXXIV.

a. Health officer, Stamford, explaining to children how mosquitoes breed in receptacles around the dump.



b. Salt marsh breeding pools, Quinnipiac Marsh, Hamden.

MOSQUITO ELIMINATION

a. Cleaning old ditch.

b. Cutting new ditch without special tools.

MOSQUITO ELIMINATION

The Botsford spade lifted ready to be plunged into the turf.

PLATE XXXVI.

a. The Botsford spade lifted ready to be plunged into the turf.

b. Removing the sod.

MOSQUITO ELIMINATION

BULLETIN 295 MAY, 1928

Connecticut Agricultural Experiment Station
New Haven, Connecticut

The Thirty-Second Report on FOOD PRODUCTS and the Twentieth Report on DRUG PRODUCTS

1927

Food and Drug Inspection and Special Studies

By

E. M. BAILEY

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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Contents and Summary

Material	Page	Sampled by or Submitted to: The Station	Sampled by or Submitted to: The Dairy and Food Commissioner	Total	Adulterated, below standard, or otherwise illegal.
FOODS					
Carbonated Beverages, etc.	310	1	152	153	15
Cacao Products, sweetened milk chocolate	310	9	0	9	...
Cereal Products, etc.:					
Bread	312	2	1	3	...
Unleavened Bread	312	2	0	2	...
Special foods, "diabetic" foods	312	14	0	14	...
Cheese	314	0	12	12	...
Eggs	314	2	60	62	47
Fats and Oils:					
Butter	315	1	13	14	2
Cottonseed oil	316	0	1	1	0
Olive Oil	316	1	17	18	3
Fruits and Fruit Products	316	1	1	2	...
Ice Cream	317	0	301	301	2
Frozen Custard	317	0	3	3	3
Meat Products:					
Frankfurt sausage	317	0	9	9	6
Meat loaf	317	1	0	1	0
Milk and Milk Products:					
Market Milk	318	128	230	358	53[1]
Cream	318	3	1	4	0
Evaporated milk, etc.	318	2	0	2	0
Human milk	318	1	0	1	...
Oysters	319	3	0	3	...
Pickles, sweet	319	0	11	11	0
Salad Dressing	319	0	1	1	0
Syrups:					
Honey	320	0	13	13	0
Maple syrup	322	1	6	7	0
Tea	322	14	0	14	...
Tomato Catsup	322	0	10	10	...
Vinegar	323	3	0	3	0
Total for foods		189	842	1031	131

[1] Includes 45 below standard only.

Material	Page	Sampled by or Submitted to: The Station	Sampled by or Submitted to: The Dairy and Food Commissioner	Total	Adulterated, below standard, or otherwise illegal.
DRUGS					
Ammonia Water	325	0	3	3	1
Amyl Nitrite	325	0	1	1	0
Borax	325	0	2	2	0
Carbon Tetrachloride	325	0	4	4	0
Calcium Hydroxide, Solution of	326	0	7	7	0
Cream of Tartar	326	0	4	4	0
Cresol, Compound Solution of	326	0	5	5	...
Ethyl Nitrite, Spirit of	327	0	27	27	15
Ferric Chloride, Solution of	328	0	8	8	1
Ferrous Carbonate, Mass of	328	0	6	6	1
Fowler's Solution	329	0	21	21	6
Glycerin	329	0	4	4	0
Iodine, Compound Solution of	330	0	6	6	2
Iron and Ammonium Acetate, Solution of	330	0	6	6	1
Hydriodic Acid, Dilute	331	0	4	4	3
Lime, Chlorinated	331	0	1	1	1
Mercuric Salicylate	332	0	2	2	0
Mercury, Mass of	332	0	3	3	1
Pepsin, Powdered	332	0	5	5	3
Peppermint, Spirit of	333	0	1	1	0
Sulphuric Acid, Aromatic	333	0	7	7	2
Thyroid	333	0	3	3	0
Total for drugs		0	130	130	37
MISCELLANEOUS					
Cod Liver Oil	334	20	0	20	0
"Denicotinized" and other tobaccos	338	35	0	35	...
Materials examined for poisons, etc.	351	55	0	55	...
Water analyses (State Water Commission)	354	17	0	17	...
Total for miscellaneous		127	0	127	...
Total for all		316	972	1288	168
Babcock glassware, etc.	354	3095	...	3095	74

The Thirty-Second Report on Food Products and the Twentieth Report on Drug Products

Food and Drug Inspection and Special Studies

by E. M. BAILEY

The work here summarized is that done for the year 1927 and largely for purposes of food and drug control as required by the Dairy and Food Commissioner in carrying out the provisions of the State food and drug laws. As usual, a good deal of our time is occupied with other inspection work, some of which, notably the inspection of cattle feeds, has materially increased the analytical work required of the department in the last two years. Cooperation with the Tobacco Station at Windsor has involved analyses, in considerable detail, of 40 or more samples of tobacco and a study of the data obtained. A summary of this work is published elsewhere.[1] Two special studies, one of cod liver oil and the other of "denicotinized" tobacco have been made and are reported here. Cooperation has been continued with the State Water Commission, with the Association of Official Agricultural Chemists, and with the Council on Pharmacy and Chemistry of the American Medical Association. The chemist in charge has continued to serve as consultant to this Council; as a member of the Executive Committee, and of the Committee on Recommendations of Referees, of the Association of Official Agricultural Chemists; and as a member of the Joint Committee on Definitions and Standards for Foods.

The increase in analytical work just noted has been in part compensated by the decrease in the number of official milk samples submitted by the Dairy and Food Commissioner in the last two years. However, the total number of samples of foods and drugs examined, exclusive of official milk samples, compares favorably with previous years on a like basis.

Credit is due to Messrs. Shepard, Fisher, Nolan, Mathis and Walden for the analytical work herein reported, and for that reported elsewhere; and to Miss Bacon for assistance in preparing reports. The courtesy of the Biochemical Laboratory in giving facilities for the feeding tests on cod liver oil, and of Miss Cannon who collaborated in the work, is also gratefully acknowledged.

---

[1] Conn. Exp. Sta., Tobacco Station Bull. 10, 1928.

FOODS.

Carbonated Beverages, etc.

One hundred and fifty-two samples of carbonated soft drinks were examined for the Dairy and Food Commissioner.

None of the samples were found to contain saccharin and all exceeded the 5 per cent minimum sugar content required by the law. The average sugar content found was about 10 per cent.

The use of artificial color is legal provided the colors are such as are permitted for use in foods, that they do not conceal damage or inferiority, and that their presence is declared on the label. A label declaration does not correct an illegal use of artificial color.

In general the products examined were correctly labeled as to statements of artificial colors and flavors, but in 15 samples declarations were absent or incomplete. Of these, 10 were samples of lemon and lime and 2 were samples of ginger ale, all containing undeclared coal tar colors.

A sample of Hyland's California Orange Drink, the concentrated and sweetened juice of oranges with lemon juice and certified color, made by the Canada Dry Ginger Ale, Inc., New York, was examined. No evidence of benzoic acid or other chemical preservatives was found and the sample appeared to be a concentrated natural fruit juice sweetened and with added permitted color.

Coal tar colors not declared on the labels were found in products obtained from the following dealers or manufacturers:

Table I. Misbranded Beverages.

No.	Flavor	Dealer
37004	Ginger ale	*Bridgeport.* Bridgeport Bottling Works
36502	Ginger ale	Bridgeport Bottling Works
36505	Lemon and lime	Coco-Cola Bottling Works
36440	Lemon and lime	*East Portchester.* The Whistle Bottling Co.
35457	Strawberry soda	*Greenwich.* P. Schinto & Sons
36877	Orange soda	*Hartford.* United Bottling Works
36427	Lemon and lime	*New Britain.* Boston Bottling Works
36426	Lemon and lime	Eureka Bottling Works
36530	Lemon and lime	*New Haven.* Clancy Bottling Works
36535	Lemon and lime	Star Bottling and Supply Co.
36531	Lemon and lime	Yale and Eagle Bottling Works
36446	Strawberry soda	*New London.* Nutmeg Club Beverage Co.
36118	Lemon and lime	*Norwich.* Marathon Beverage Co.
36315	Lemon and lime	*So. Manchester.* Glenwood Bottling Works
36322	Lemon and lime	*Willimantic* Hosmer Mt. Spring Bottling Works.

Cacao Products.

A sample of sweetened milk chocolate which was made according to a known formula and upon which a considerable amount

of collaborative work has been done[1] was examined for total milk protein, total fat and total milk fat, and for comparison a number of market samples of milk chocolate were examined for the same ingredients. Total milk protein was determined by the method of Lepper and Waterman,[2] total fat by the tentative method,[3] and milk fat by the method of Greenleaf.[4] Values for these items as determined by previous collaborative tests and as determined by the methods above cited, are summarized as follows:

	Milk Protein %	Total Fat %	Xylene No. %	Milk Fat %	Milk Solids %
Previously determined. avg..........	2.56	40.16	....	4.33	12.0[1]
Results by above methods...........	2.39	....	3.45	4.55	12.2[1]

[1] Basis of 4.64% lactose as determined.

Milk solids as previously calculated were taken to be the sum of the milk protein (casein x 1.25), the milk fat (estimated from Reichert-Meisl value), and lactose with an added correction of 5 per cent of the sum of these for milk ash. On the basis of the new results the solids are taken as the sum of milk protein (determined directly), milk fat (estimated from the xylene number), and lactose with the same correction (5 per cent), for milk ash.

As the eight market samples of milk chocolate were not examined for inspection purposes but only for a study of methods brand names are not given, but the following summary may be made.

	Milk Protein %	Total Fat %	Xylene No. %	Milk Fat %	Milk Solids %
Maximum......................	3.83	41.99	5.36	5.67	15.28
Minimum......................	1.17	28.95	2.35	2.85	8.60
Average......................	2.86	34.61	4.10	4.61	11.78

Lactose was not determined in these market samples and milk solids were estimated by a formula derived from those given by Baier and Neumann[5] and by which milk solids is taken as the sum of the milk fat and 2.51 times the milk protein. This method of calculation applied to the experimental sample referred to above gave 10.6 per cent for milk solids instead of 12.2 per cent. It is probable therefore that the milk solids as calculated for these market samples are somewhat too low. The sample showing the minimum of milk solids had a high milk fat content indicating that the product was made with cream.

[1] Jour. A. O. A. C., 9, p. 470, 1926. (Sample 8 D. M.)
[2] Jour. A. O. A. C., 8, p. 706, 1926
[3] Jour. A. O. A. C., 9, p. 468, 1926
[4] Jour. A. O. A. C., 10, p. 396, 1927
[5] Zeitr. Nahrs. und Genussmtl., 18, 1909

Cereal Products, etc.

BREAD.

Three samples of bread were examined. Two were whole wheat products and one, No. **7485**, was Thomas' Gluten Bread, the latter submitted by Dr. Herman O. Mosenthal of New York. No. **8105** was Linn's Vitamin Whole Wheat bread, manufactured by the Storck Baking Co., Parkersburg, W. Va. No. **35459** was whole wheat bread sold locally and submitted by the Dairy and Food Commissioner.

Analyses:

No.	7485	8105	35459
	%	%	%
Moisture	40.92	35.77	34.80
Ash	2.02	2.58	....
Protein	11.61	10.23	9.40
Fiber	0.70	1.29	....
Carbohydrate	43.48[1]	45.95	....
Fat	1.27	4.18	....

[1] Starch 32.27%, soluble carbohydrate 6.41%.

Thomas' Gluten Bread, so-called, does not greatly differ in composition from average wheat bread. Linn's Vitamine Whole Wheat bread bore an analysis on the wrapper which was misleading in that it was computed on the air-dry basis whereas the bread contains about 36 per cent of water.

Unleavened Bread.

Two samples of unleavened bread were submitted by the Dietetic Department of the New Haven Hospital. No. **6751** was Matzos manufactured by Myer London, New York. No. **6752** was Matzos manufactured by the D. Manischewitz Co., Cincinnati, Ohio.

Analyses:

No.	6751	6752
	%	%
Moisture	8.02	8.13
Ash	2.13	1.58
Protein	12.13	10.69
Fiber	0.17	0.12
Carbohydrate	76.95	78.92
Fat	0.60	0.56

So-Called "Diabetic" and Special Foods.

Products of this class which have been examined in the past year are listed and their analyses given in Table II.

TABLE II. ANALYSES OF SO-CALLED DIABETIC AND SPECIAL FOODS

No.	Manufacturer and Name of product	Moisture %	Ash %	Protein %	Fiber %	Carbohydrate: Starch + Sol. %	Carbohydrate: Other by diff. %	Fat %
	MacDowell Bros., Brockville, Ont.							
7133	Gluten flour	9.37	0.49	43.66[1]	0.38	39.44	5.69	0.97
	Curdolac Food Company, Waukesha, Wis.							
7965	Wheatso Flour	5.66	13.21	22.88	5.45	22.78[2]	22.56	7.46
7967	Diabeto flour	4.55	13.62	31.06	1.03	7.16[3]	29.93	12.65
7968	Improved flour	5.05	8.79	40.13	1.75	4.79[4]	29.81	9.68
7969	Johnny Cake flour	5.00	9.70	35.25	3.50	18.94[2]	15.29	12.32
7970	Nu-Special flour	8.34	7.08	42.56	3.13	2.41[5]	35.30	1.18
7971	Soya flour	5.35	4.20	42.25	4.13	10.00[4]	17.81	16.26
7966	Breakfast food	4.45	9.30	15.19	10.80	8.25[6]	45.55	6.46[7]
	Therapeutic Foods Co. Inc., New York, Agents							
7781	Biscuits Mousseline Glutines (Charrasse)	9.00	2.11	15.25	0.55	69.65[8]		3.44
7782	Glutin Mousseline (Charrasse)	9.21	1.40	16.63	0.70	68.54[8]		3.52
	Miscellaneous							
7779	Wallace Toast	9.10	3.23	17.22	2.20	64.31[9]		3.94
8010	Original Meat (Nature's Original Food Co., Brooke, Virginia	61.95	2.38	17.88	0.44	10.90		6.45
6394	Diabetiker Kakao (Freia Chocolade Fabrik, Oslo, Sweden)	4.24	5.43	23.38	4.73	14.63	25.79	21.80
6395	Diabetiker Chocolade (Freia Chocolade Fabrik, Oslo, Sweden)	2.37	3.33	19.25	3.10	10.71	14.88	46.36

1 Factor 5.7
2 Starch present.
3 Starch none or trace.
4 Starch trace.
5 Starch none.
6 Starch 1.37, balance largely or partly due to agar agar.
7 In part mineral oil.
8 Over 3/4 is starch.
9 About 9/10 is starch and soluble carbohydrate.

The Curdolac products were examined for the Council on Pharmacy and Chemistry of the American Medical Association. The Charrasse products, examined for a patient, are not adapted to the diet of anyone with impaired carbohydrate tolerance. Wallace toast is said to be offered as a weight reducing food but its usefulness for such purpose is not apparent from the analysis. The label on the package of Original Meat explains that it is a vegetable product made from nuts and grain. The Swedish cocoa and chocolate are no more adapted to the diabetic diet than are ordinary cocoa and chocolate.

Cheese.

American cheese, also known as Cheddar cheese and American Cheddar cheese, is cheese made by the Cheddar process, from heated and pressed curd obtained by the action of rennet on whole milk. It should not contain more than 39 per cent of water, and, in the water-free substance, not less than 50 per cent of milk fat.

Cream cheese is the unripened cheese made by the Neufchatel process from whole milk enriched with cream. It contains, in the water-free substance, not less than 65 per cent of milk fat.

Under the laws of some states it is permissible to call cheese made from whole milk "full cream cheese". This is confusing since cream cheese is a separate and distinct product.

Twelve samples of American cheese were examined for the Dairy and Food Commissioner. Three of these were sold as cream, or full cream, cheese but they were evidently cheese of the Cheddar type, and the fat content, on the dry basis, corresponded to the requirements for Cheddar cheese.

The moisture in the samples examined ranged from 31 to 37.4 per cent and the fat content, on the dry basis, ranged from 48.6 to 52.2 per cent. The average moisture was 33.4 per cent and the average percentage of fat in the dry substance was 50.7 per cent.

Eggs.

Under the State law eggs held for more than 15 days in any place where the temperature is reduced by means of artificial refrigeration are cold storage eggs and must be designated as such when sold or offered for sale. Eggs preserved by any other artificial process must be labeled "preserved eggs".

When the price of locally gathered eggs is high and the best grades of cold storage eggs are available there is commercial advantage in offering the storage product as and for fresh eggs. Later as prices for the two types of products become more nearly equalized the abuses cease because there is little if any commercial gain to be made.

It has been estimated that only about 10 per cent of the eggs produced are placed in cold storage. Withdrawals begin during July and by the end of the year three-fourths or more of the total holdings may-have been removed. The balance is used up by the 1st of March. The greatest abuses in the marketing of eggs occurs during the fall and early winter months.

It is evident that laboratory examinations alone cannot determine whether or not eggs are offered or sold in violation of the statute relating to cold storage eggs, but the evidence procured by such examinations, supplemented with inspection evidence, will generally lead to reasonably definite conclusions. Laboratory tests aim chiefly to determine whether or not eggs are fresh judged by the usually accepted characteristics of fresh eggs as determined by candling, the condition of the eggs as broken out of the shell and the ammonia content. If not classified as fresh the evidence may give further suggestion as to probable history which will be of service in supplementing inspection evidence. Large air spaces accompanied by low ammonia content indicate eggs held at low temperatures or at cold storage temperatures. Large air spaces with high ammonia content indicate eggs held under less favorable conditions, such as eggs held too long by the retailer or held by the producer in anticipation of higher prices.

In judging market eggs the characteristics of fresh eggs as defined by various workers[1] and our own observations made upon eggs held under known conditions[2] have been used as a guide.

Of 62 samples examined, 60 of which were submitted by the Dairy and Food Commissioner, all were edible, with one exception, but 46 were not sold under proper descriptions.

Fats and Oils.

BUTTER

Thirteen samples of butter were examined for moisture and fat.

The Federal law required not less than 80 per cent of milk fat but has no specification for moisture. By regulation in this State butter must contain not less than 80 per cent of fat and not more than 15.99 per cent of water.

Of the samples examined 12 were above the standard for fat, ranging from 82.7 to 86.7 per cent, and substantially within the limit for moisture, the range being 10.4 to 16.2 per cent. One sample, **36521**, sold by Kingsley and Smith of Hartford and

[1] U. S. Dept. Agr., Bull. 565, p. 13 (1918); Penn. Dept. Agr., Bureau of Foods, Bull. 17, p. 44 (1919).

[2] Conn. Exp. Station, Bull. 255, 1923.

said to be Elgin Creamery butter, was 0.4 per cent low in fat and about 0.5 per cent high in moisture. One sample also, **35654**, sold by J. S. Brown of South Manchester was 4/10 of an ounce short in weight.

One unofficial sample was analyzed and found to meet the requirements for both moisture and fat.

COTTONSEED OIL.

One sample of cottonseed oil was examined and passed.

OLIVE OIL.

Seventeen samples were examined for the Dairy and Food Commissioner and one unofficial sample was tested. Fifteen samples were passed as genuine and three were found to be adulterated. Cottonseed oil was present in all of the adulterated samples and they responded also to the test for sesame oil. These samples were all of the same brand, Dag-ni-nos, bottled by J. R. Dagnino Co., Boston. Two of the samples were purchased of the New England Grocery of Middletown and the third was sold by the Heimler Co. of Hartford.

Fruits and Fruit Products.

Fresh grape fruit, **6577**, submitted by Dr. E. P. Joslin, said to be a rare variety and not obtainable in the market, was analyzed as follows:

Weight as received 443.4 grams. Waste, rind, core and seeds, 114 grams. Edible portion 329.4 grams (74.3%).

Analysis of edible portion:

Water	89.7%
Ash	0.5
Protein	0.8
Fiber	0.4
Carbohydrate:	
Sugar (total as invert)	7.6
Undetermined	1.0
Fat (ether extract)	trace

This analysis agrees with that of canned grape fruit (Poms), which we have made; and, so far as sugar content is concerned, it is in accord with published analyses of our ordinary grape fruit.

A sample of currant jelly, **35650**, submitted by the Dairy and Food Commissioner, was not found to be adulterated.

Ice Cream, etc.

Three hundred and one samples of ice cream were analyzed for the Dairy and Food Commissioner. Of these only two samples, both made by Foot Farms, Bridgeport, were below the legal standard of 8 per cent for plain ice cream and 6 per cent for fruit and nut ice cream.

The distribution of samples on the basis of fat content is as follows:

Per cent of fat	No. of samples	Per cent of total
8.0 to 9.9	34	11.3
10.0 to 11.9	78	25.9
12.0 and above	187	62.1
7.9 and below	2	0.7

Of nearly 600 samples examined in the last two years only 5 samples have been found containing less than the legal percentage of milk fat. Nearly 2/3 of the total number have contained over 12 per cent.

Frozen custard is subject to the same sanitary regulation as is ice cream, and likewise may be sold when containing less than the standard amount of fat provided the true percentage is declared at the time and place of sale. Three samples, all taken at Savin Rock, West Haven, were illegal in that they contained less than the declared percentage of fat. Declarations of 5 and 6 per cent were made but the products contained only about 4 per cent.

Meat Products.

Nine samples of frankfurt sausage were examined and six were found to contain cereal or other starchy material which was not declared by label or by signs displayed at the time and place of sale.

The illegal products were found at the following places:

	Dealer	Manufacturer
New Haven:	Persky and Kavanaugh	F. J. McNamara, Bridgeport
	New England Market	F. J. McNamara, Bridgeport
	Reliable Meat Market	Chas. Hertler, New Haven
Stamford:	B. Sermet	Kline and Gmahle, Stamford
	New York Market	T. McNamara, Bridgeport
Waterbury:	A. M. Calo	Albany Packing Co., Albany, N.Y.

A sample of beef loaf, **6094**, was analyzed and found to contain about 10 per cent of starch. Cereal or starchy material is recognized as a proper ingredient of beef loaf and no declaration of the added starchy matter is necessary.

Milk.

Three hundred and fifty-eight samples of milk have been analyzed. One hundred and twenty-seven were official samples taken by the Dairy and Food Commissioner and the remainder were unofficial samples (103), taken by the same agency and samples (128), examined for producers or others interested.

The distribution of official samples is as follows:

	No. of samples	Per cent
Not found adulterated	74	58.3
Adulterated by watering	8	6.3
Below standard:		
in solids and solids-not-fat	22	17.3
in solids, fat and solids-not-fat	23	18.1
Totals	127	100.0

The sources from which adulterated samples were obtained are given in Table III.

Three samples of bottled cream were examined. Two contained 42 and 53 per cent of fat respectively. The third was examined for preservatives only but none were detected.

Evaporated Milk, etc.

A sample of Nestle's cream in sealed tin containers, and one of Borden's Evaporated milk were analyzed as follows:

No.		Solids %	Ash %	Protein %	Fat %	Sugar %
8119	Nestle's Cream	32.38	0.56	2.39	26.04	3.39
8118	Borden's Evaporated Milk	26.22	1.61	6.68	7.82	10.11

Human Milk.

One sample, **6346**, was submitted by the City Board of Health of New Haven. It contained 3.2 per cent of fat, 1.1 per cent of protein, 0.2 per cent of ash and 7.2 per cent of sugar.

Table III. Adulterated Milk.

Containing added water.

No.	Dealer	Solids	Fat
	Guilford		
37614	C. O. Bartlett	10.49	3.2
37627	C. O. Bartlett	10.57	3.0
	Mt. Carmel		
37957	S. Kaufman	11.30	3.6
	New Milford		
37322	Thomas Lillis	6.82	2.1
	Southbury		
35607	Dominick Kamaski	5.15	1.6
35969	Dominick Kamaski	8.16	2.4
	Stepney		
35795	Frank Musbek	11.41	3.9
	Wallingford		
37960	Chas. Bernasky	9.75	3.0

OYSTERS.

A sample of oysters, **7653**, shipped out of the State by a local dealer, and returned as unfit for food, were examined. Also a sample, **7654**, of the same lot as proposed for shipment was submitted by the dealer. No. **6343** was a sample from the same dealer examined earlier in the year. Analyses are as follows:

	7653	7654	6343
New weight sample	124.8 gms.	167.7 gms.	......
Weight of liquor	19.7 "	17.7 "	......
Weight of drained oyster meats	105.1 "	150.0 "	......
Loss on boiling meats	58.99 %	45.00 %	49.90%
Solids in oyster meats	18.21	21.96	21.50
Ash in oyster meats	1.23	1.74	1.59
Salt in oyster meats	0.03	0.16	0.40
Ash in liquor	0.92	1.39	......
Salt in liquor	0.19	0.66	......

The oysters had been treated with saline solution according to approved methods. Analysis of **7654** oyster before shipment was substantially the same as that of oysters from the same source examined earlier. The solids, ash and salt in the rejected oysters are considerably less, and the loss in boiling considerably more than in the oysters as prepared at the plant and indicate more water in the oysters as returned than in those before shipment. No evidence of unwholesomeness could be detected as judged by the odor and general appearance. Bacteriological examinations were made elsewhere (State Department of Health).

PICKLES.

Eleven samples of sweet pickles were examined for saccharin but none were found to contain it. The samples were submitted by the Dairy and Food Commissioner.

SALAD DRESSING.

One sample of Mayonnaise dressing, **36845**, was analyzed. It was made by Otto Seidner Inc., Westerly, R. I.

Analysis:

	As analyzed %	Water-free basis %
Moisture	27.07	....
Ash	1.71	2.34
Protein	2.75	3.77
Carbohydrate and fiber, by difference	2.84	3.89
Fat	65.63	90.00

On the moisture-free basis the above analysis is substantially the same as that of a previous sample of the same brand examined in this laboratory.[1]

[1] Conn. Exp. Station Bull. 255, p. 206-7, 1923.

There is no accepted standard for mayonnaise dressing. but a definition and standard is under consideration by the Committee on Definitions and Standards.

HONEY.

The numerical limits as given in the definition and standard for honey[1] are not over 25 per cent of water, not over 0.25 per cent of ash and not over 8 per cent of sugar (sucrose).

Thirteen official samples of strained honey were examined and the results are given in Table IV. One sample was examined for a purchaser.

No evidence of adulteration was found. The water content was not excessive in any sample. The ash varied from 0.06 to 0.27 per cent and the sucrose ranged from 0.11 to 8.06 per cent. The invert sugar content was within the usual limits ranging from about 72.5 to 78.0 per cent. For the detection of added invert sugar recourse is had to the fact that commercial processes for the manufacture of invert sugar result in the formation of furfural which may be detected by suitable tests. The resorcin and the aniline chloride tests gave no indication of commercial invert sugar in any of the samples examined. The procedure proposed by Auerbach and Bodlander[2] may be of value for the purpose of detecting added invert sugar and the possibilities of this method are being investigated by the referee on honey.[3]

Extensive analyses of authentic samples of honey from various sources have shown that the differences between invert polarizations of honey at 20° C. and 87° C. are fairly constant, ranging between the rather narrow limits of 23 and 30 in a large proportion of cases. Differences substantially less than 23 are indications of added glucose. Several methods of estimating glucose from polarization values have been proposed. One of these is Browne's formula[5] which is generally used in control work. The Beckman test is a qualitative test of some value but negative results do not necessarily mean absence of commercial glucose because some of such glucose gives no iodine reaction.

In the samples which we have examined the differences between invert polarizations at 20° C. and at 87° C. were all between 23.2 and 26.4 with one exception where the difference was 20.5 but in which case, **31752**, one of the polarization values is questionable. The Beckman tests were negative in all cases but the reservation noted above must be made. Estimation of glucose by means of Browne's formula indicates no considerable additions of commercial glucose. On the whole there is no acceptable evidence of adulteration in any of the samples.

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1 S. R. A., F. D. No. 2.
2 Zeit. Nahr. und Genussen., 47, 233, 1924
3 H. A. Schuette., A. O. A. C. referee on honey.
4 U. S. Dept. Agr. Bur. Chem. Bull. 110.
5 A. O. A. C. Methods of Analysis, p. 201.

TABLE IV. ANALYSES OF HONEY.

No.	Brand, Manufacturer or Dealer	Water	Ash	Acidity (as formic acid)	Difference between invert polarization at 20° and at 87°	Sucrose	Invert Sugar	Glucose (Beckmann test)	Added invert sugar (Resorcin and Aniline Chloride tests.)
		%	%	%		%	%	%	%
31765	Atlantic and Pacific Tea Co. A. & P.	17.68	0.13	0.25	24.7	0.71	71.34	negative	negative
31754	James Butler Inc., New York, Peerless	15.21	0.13	0.13	26.2	0.42	74.15	negative	negative
31784	H. W. Coley, Westport, Conn.	15.24	0.11	0.11	26.2	0.60	77.17	negative	negative
31761	The Wm. Edwards Co., Cleveland, Ohio	13.17	0.07	0.09	24.8	1.76	74.80	negative	negative
31792	W. O. Gilbert, Wilton, Conn.	12.44	0.25	0.07	23.7	2.02	72.82	negative	negative
31750	Hoffman and Hanch Inc., Woodhaven, N. Y., H & H	15.18	0.11	0.07	24.6	7.34	71.39	negative	negative
31791	F. H. Liggett & Co., New York, Premier	10.64	0.10	0.09	25.2	8.06	72.77	negative	negative
31786	The John G. Paton Co. Inc., New York, Golden Blossom	11.45	0.09	0.14	26.4	0.82	77.59	negative	negative
33343	A. I. Root Co., Medina, Ohio, Airline	15.53	0.08	0.08	24.7	1.05	76.35	negative	negative
31752	E. Vanderwerken, Stamford, Conn., Highland	15.32	0.27	0.12	20.5[1]	2.18	71.80	negative	negative
34443	Nellie A. White, Hockanum, Conn.	....	....	....	26.0	....	72.62	negative	negative
31778	R. F. Wixon, Dundee, N. Y.	13.01	0.06	0.07	24.5	2.17	74.34	negative	negative
31769	A. W. Yates, Hartford, Conn.	14.81	0.11	0.09	23.2	0.11	73.82	negative	negative

[1] One polarization value doubtful.

MAPLE SYRUP.

Seven samples of maple syrup were examined. These were ld as pure products and no evidence of added sugar syrup or her adulteration was found. Six of these samples were subitted by the Dairy and Food Commissioner.

TEA.

Fourteen samples of tea were examined for Mr. Geo. F. itchell, U. S. Supervising Tea Examiner, in connection with s study of the effects of different methods of packing upon e quality of tea.

TOMATO CATSUP (KETCHUP).

Ten samples of tomato catsup were submitted by the Dairy and od Commissioner. So far as these products are representative the present day article the results show a marked contrast those found in an inspection made in 1910.[1] At that time nzoate of soda was commonly used and artificial coloring matter en added. In the samples recently examined benzoate of soda s not found and no artificial colors were detected.

Analyses are given in Table VI.

The composition now as compared with that found in earlier aminations may be seen from the following summary.

	1927 %	1910 %
al Solids (as purchased basis)	20.2 to 36.0	7.3 to 32.5
(as purchased basis)	1.9 to 3.6	0.7 to 5.2
-free ash (as purchased basis)	0.7 to 1.1	0.6 to 1.8
-free ash (water and salt-free basis)	2.2 to 4.9	3.2 to 20.8
oluble solids (as purchased basis)	1.2 to 1.6	1.2 to 6.1
oluble solids (water and salt-free basis)	3.6 to 8.1	7.0 to 45.0
tein (as purchased basis)	1.7 to 2.4	0.8 to 3.1
tein (water and salt-free basis)	4.6 to 12.5	5.4 to 24.6
er (as purchased basis)	0.4 to 0.6	0.3 to 0.8
er (water and salt-free basis)	1.2 to 2.8	1.4 to 10.9

t appears that in the products recently examined the total ds exceed 20 per cent in the material as sold whereas in the lier inspection many samples contained less than 20 per cent minimum being less than 10 per cent. Salt-free ash in the , salt-free material is 5 per cent or less whereas this was about minimum found in earlier samples, the maximum being over per cent. The percentages of protein and fiber are also distly lower in the recently examined products.

No standards have been adopted for tomato catsup but on the is of our earlier analyses it appeared that reasonable limits

[1] Conn. Food and Drug Report, 1910, p. 521, et seq.

of composition for a standard catsup might be, in the water and salt-free material, not more than 15 per cent of insoluble solids, not more than 7 per cent of ash, not over 4 per cent of fiber and not more than 12 per cent of protein. All of the samples in the recent inspection come well within these limits.

For the determination of insoluble solids the official method directs to wash 20 grams of material by repeated centrifugalization and transfer the insoluble residue to a previously dried filter, dry at 100° C. for 2 hours, cool, and weigh. We have found it more convenient to determine the soluble solids and obtain the insoluble solids by difference.[1] This avoids the transfer of insoluble material and the use of dried and weighed filters. The collected centrifugal washings are made up to a convenient volume and solids determined in aliquot portions. The aliquots are evaporated on a steam bath followed by short drying (30 mts.), at 100° C. to reduce the caramelization of sugar. The results as a rule are a little higher by the indirect method but the differences are not significant for a determination of this kind.

The comparative figures are as follows:

TABLE V. INSOLUBLE SOLIDS IN CATSUP.

No.	Total solids	Insoluble solids		Difference by indirect method
		direct method	indirect method	
	%	%	%	%
34429	35.99	1.17	1.27	+0.10
34435	29.83	1.38	1.38	±0.00
34436	31.03	1.50	1.48	—0.02
34437	33.58	1.15	1.43	+0.28
34438	32.34	1.45	1.90	+0.45
34449	29.79	1.55	1.57	+0.02
36250	35.46	1.47	1.71	+0.24
36258	25.10	1.51	1.75	+0.24
36259	24.50	1.30	1.38	+0.08
36262	20.24	1.48	1.38	—0.10

The differences do not much exceed 0.25 per cent with one exception. The average variation is +0.13 per cent.

VINEGAR.

Three samples of vinegar, all submitted by producers, were examined for solids and acidity.

[1] Suggested by C. E. Shepard.

TABLE VI. ANALYSES OF TOMATO CATSUP.

No.	Manufacturer and Brand	Total solids	Solids insol. in water	Ash	Salt (NaCL)	Salt-free ash	Protein (N x 6.25)	Fiber	In the water-and salt-free material: Insol. Solids	Ash	Protein	Fiber
		%	%	%	%	%	%	%	%	%	%	%
34429	American Packing Corp., Evansville, Ind. Triple A	35.99	1.17	4.12	3.38	0.74	1.89	0.39	3.59	2.27	5.80	1.20
34435	Atlantic and Pacific Tea Co., Brockport, New York, A & P	29.83	1.38	2.95	2.14	0.81	1.80	0.44	4.98	2.92	6.50	1.59
36262	Austin, Nichols & Co., New York, Anco	20.24	1.48	2.75	1.85	0.90	2.29	0.52	8.05	4.90	12.46	2.83
36258	Wm. Boardman & Sons, Hartford, Conn. Clover Leaf	25.10	1.51	2.68	1.87	0.81	1.93	0.47	6.49	3.48	8.30	2.02
34436	Curtice Bros., Rochester, N. Y. Blue Label	31.03	1.50	3.62	2.88	0.74	1.70	0.54	5.33	2.63	6.04	1.92
34437	First National Stores, Inc., Norwich, Conn	33.58	1.16	3.91	3.13	0.78	1.89	0.40	3.80	2.56	6.20	1.31
36250	H. J. Heinz & Co., Pittsburgh, Pa.	35.46	1.47	4.01	3.30	0.71	1.48	0.47	4.57	2.21	4.60	1.46
34449	Libby, McNeil and Libby, Chicago	29.79	1.55	3.08	1.95	1.13	2.43	0.44	5.56	4.06	8.72	1.58
36259	P. J. Ritter Company, Philadelphia	24.50	1.30	3.12	2.30	0.82	1.85	0.43	5.85	3.69	8.33	1.94
34438	T. A. Snider Preservative Co., Chicago	32.54	1.45	4.38	3.62	0.76	1.84	0.57	5.02	2.63	6.37	1.97
	Maximum	35.99	1.55	4.38	3.62	1.13	2.43	0.57	8.05	4.90	12.46	2.83
	Minimum	20.24	1.16	2.68	1.85	0.71	1.70	0.39	3.59	2.21	4.60	1.20
	Average	29.81	1.40	3.46	2.64	0.82	1.91	0.47	5.32	3.14	7.33	1.78

DRUGS.

Ammonia Water.

Ammonia water should contain not less than 9.5 nor more than 10.5 per cent of ammonia (NH_3), and the stronger solution should contain not less than 27 nor more than 29 per cent.[1]

Three samples were examined, one of which was very deficient.

Table VII. Analyses of Ammonia Water.

No.		Dealer	Per cent ammonia (NH_3)
36131	*Hartford:*	South Green Pharmacy	9.0
36327	*Meriden:*	Broderick and Curtin	0.3
36302	*Waterbury:*	Waterbury Drug Co. (26%)	26.9

Amyl Nitrite.

One sample of amyl nitrite was examined. This substance should contain not less than 80 per cent of amyl nitrite[2] and 89 per cent was found in the sample examined. The sample was labeled "for inhalation only" and the manufacturer was Eli Lilly & Co.

Borax.

Two samples were examined. One was 20 Mule Team Borax and the other was Powdered Borax made by the United Drug Co., Boston. Both of these products were high in actual borax due to loss of some water of crystallization. On the basis of 5 molecules of water the samples in the order named, showed approximately 98 and 100 per cent of sodium tetraborate.

Carbon Tetrachloride.

Four samples of this product were examined, none of which claimed U. S. P. grade, but were marked "technical" or "not for medicinal use". The samples, therefore, are not judged on the basis of U. S. P. specifications. They contained from 0.1 per cent to 0.37 per cent of carbon disulphide, from 0.6 mgms. to 18 mgms. per 100 cc. of non-volatile matter at 100° C., and no chloride, free chlorine, aldehyde or material carbonizable by sulphuric acid except in one sample which contained a trace of carbonizable material.

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[1] U. S. P. X, p. 55, 56.
[2] U. S. P. X, p. 49.

Cream of Tartar.

Four samples of cream of tartar (acid potassium tartrate), were examined but only one of these was sold as a U. S. P. article. This was a product of the United Drug Co., Boston, and contained 99.1 per cent of acid potassium tartrate which is very close to the standard required (99.5). The other samples ranged from 98.2 to 98.8 per cent pure.

Compound Solution of Cresol.

This solution should contain cresol in the amount of 46 to 52 per cent by volume. The five samples examined contained 46 to 51 per cent and were satisfactory. The further stipulation that 90 per cent of the dry cresols should distill beween 195° C. and 205° C. was not met. It has been pointed out by Griffin[1] however, that the U. S. P. method of assay does not give distillation results which meet the requirements of the standard, for the reason that potassium carbonate is not a suitable drying agent for the liberated cresols. Dehydrated copper sulphate is satisfactory for the purpose according to this investigator.

Solution of Calcium Hydroxide.
(Lime Water)

Lime water should contain not less than 0.14 gram in 100 cc of solution at 25° C. Prepared at lower temperatures more calcium is held in solution, e. g. at 15° C. 100 cc will contain about 0.17 gram of calcium hydroxide. At temperatures above 25° C. the amount of calcium in solution diminishes.

Seven samples were examined and all substantially met the standard for this product.

Analyses are given in Table VIII.

Table VIII. Analyses of Lime Water.

No.		Dealer	Mfr.	Calcium hydroxide gm/100 cc
36418	*Derby:*	Geo. H. Hardy	Own make	0.17
36260	*Middletown:*	Liggett's Drug Store	Own make	0.13
36265	*New London:*	Nichols and Harris	Own make	0.14
36518	*Unionville:*	Paul F. Flynn	Own make	0.13
36254	*Waterbury:*	Apothecaries Hall	Own make	0.14
36261	*West Hartford:*	Allen B. Judd Co.	Own make	0.15
36270	*Whitneyville:*	Country Club Pharmacy	Own make	0.15

1. Jour. Am. Pharm. Asso., *15*, 3, 196 (1926).

Spirit of Ethyl Nitrite.
(Sweet Spirit of Nitre).

This preparation is an alcoholic solution of ethyl nitrite containing not less than 3.5 nor more than 4.5 per cent of ethyl nitrite, ($C_2H_5NO_2$).

Quite as much care should be exercised in preserving this article as in the preparation of it. The finished product should be kept in well-stoppered, amber-colored bottles, in a cool, dark place. If properly kept it will retain its strength for a considerable length of time. The solution is said to have been kept for several years without appreciable loss of strength. A sample prepared in this laboratory and kept for 3 months in a tightly stoppered bottle, protected from light but at room temperature, lost 8 per cent of the total ethyl nitrite. If the solution had been kept at a lower temperature the deterioration no doubt would have been much less.

In 1911 of thirty-four samples examined, thirty were found considerably below standard. In 1923 forty-eight samples were analyzed and thirteen found to be low in ethyl nitrite. During the past year twenty-seven samples were tested and more than one-half (15), of the number were considerably below the minimum of 3.5 per cent. The improvement noted in 1923 is not maintained in the latest inspection.

Analyses are given in Table IX.

Table IX. Analyses of Spirit of Ethyl Nitrite

No.		Dealer	Ethyl nitrite, per cent
36343	*Ansonia:*	E. W. Smith & Co.	3.8
36349	*Branford:*	Branford Pharmacy	4.1
36400		The Spaulding Co.	1.8
37028		The Spaulding Co.	2.3
36402		William's Drug Store	2.3
37030		William's Drug Store	3.3
36894	*Chester:*	H. A. King	3.6
36898	*Granby:*	Loomis Bros.	3.9
36333	*Naugatuck:*	Leary's Drug Store	2.7
37019		Leary's Drug Store	1.7
36339		Geo. Smith & Son	3.7
36409	*Shelton:*	E. J. Barden	3.1
37022		E. J. Barden	2.9
36411		Mahoney's Corner Drug Store	3.2
36338	*Seymour:*	Geo. Smith & Son	2.9
37021		Geo. Smith & Son	3.9
36405	*Thompsonville:*	Thompsonville Drug Co.	2.4
37032		Thompsonville Drug Co.	3.2
36268	*Torrington:*	Claxton's Pharmacy	1.7
37035		Claxton's Pharmacy	1.8
36330	*Wallingford:*	W. P. Lynch	3.3
36255	*Waterbury:*	Apothecaries Hall Co.	1.2
37018		Apothecaries Hall Co.	1.5
36269	*Whitneyville:*	Country Club Pharmacy	3.8
36346	*Winsted:*	Bannon's Drug Store	3.1
36344		The Case Drug Store	2.2
37034		The Case Drug Store	3.7

Solution of Ferric Chloride.

Solution of Ferric Chloride should contain not less than 10 per cent nor more than 11 per cent of iron (Fe). A considerable excess of iron was found in two samples but one of these, **36337**, by a declaration of specific gravity showed that it differed from the U. S. P. standard.

Eight samples were examined and the results are given in Table X.

Table X. Analyses of Solution of Ferric Chloride.

No.		Dealer	Per cent of iron (Fe)
36113	*Baltic:*	Baltic Pharmacy	10.66
36413	*Derby:*	Blume's Pharmacy	10.46
36412		C. F. Hotchkiss	12.28
36146	*Fairfield:*	Clampett's Pharmacy	10.76
36132	*Hartford:*	J. M. Rosenthall	10.97
36337	*Naugatuck:*	Cross Drug Store	12.35
36300	*Waterbury:*	Turgeon's Drug Store	11.44
36144	*Westport:*	The Bridge Pharmacy	10.75

Mass of Ferrous Carbonate.

Mass of ferrous carbo[illegible]nate (Vallet's Mass), should contain not less than 35 per cent of fe[illegible]rous carbonate, $FeCO_3$.[1] Saccharated ferrous carbonate[2] is a somew[illegible]hat similar preparation containing not less than 15 per cent of ferr[illegible]ous carbonate. Blaud's Mass is not a U. S. P. preparation but there is [illegible] an article known by that name and is said to be the powder from [illegible]which Blaud's pills are made. A sample, **7784**, sold as "Blaud's [illegible]Mass" was found to contain about 25 per cent of ferrous carbonat[illegible].

Six samples were collected by the Dairy and F[illegible]ood Commissioner. There was evidently some misunderstanding [illegible] on the part of druggists as to what article was desired although [illegible] mass of ferrous carbonate was asked for. Three of the articles [illegible] obtained were correctly labelled and met the standard for the articl[illegible]e called for. Two others were labelled "Blaud's Mass" in each ca[illegible]se and may have been the article as labelled but they were not the ar[illegible]ticle demanded. One preparation was labelled ferrous carbonate. [illegible] It was too low in iron for the article called for, too high for saccharated ferrous carbonate.

The analyses are given in Table XI.

[1] U. S. P. X, p. 234
[2] U. S. P. X, p. 152

TABLE XI. ANALYSES OF MASS OF FERROUS CARBONATE.

No.		Dealer	Manufacturer	Per cent of $FeCO_3$ %
36342	*Ansonia:*	Bristol Drug Co.	Malinckrodt	43.75
36133	*Hartford:*	J. Robens (Blaud's Mass)	Powers, Weightman, Rosengarten	11.91
36314	*Putnam:*	Geo. E. Dresser	Claflin & Co.	36.54
36141	*So. Norwalk:*	Irving Drug Co. (Blaud's Mass)	....	19.43
36331	*Wallingford:*	Modern Drug Co. (Ferrous Carbonate)	....	30.90
36328		Moran's Drug Store	....	41.36

FOWLER'S SOLUTION.

This is a solution of sodium arsenite and should contain not less than 0.975 per cent nor more than 1.025 per cent of arsenic trioxide (As_2O_3).

Twenty-one samples were examined. Six were considerably outside the limits as specified in the standard.

The analyses are given in Table XII.

TABLE XII. ANALYSES OF FOWLER'S SOLUTION.

No.		Dealer	Manufacturer	Per cent of arsenic trioxide (As_2O_3).
36401	*Branford:*	The Spaulding Co.	....	1.025
36407	*Derby:*	East Side Pharmacy	....	1.047
36415		The Purdy Drug Co.	Squibb's	0.973
36348	*East Haven:*	Metcalf's Drug Store	....	0.966
34434	*Hartford:*	G. Fox and Co.	....	1.006
34445	*New Haven:*	Liggett's Drug Store	Liggett's	0.948
34439	*Norwich:*	James C. Mara	Lehn & Fink	0.950
36312	*Putnam:*	G. N. Lemaitre	Eastern Drug Co.	0.932
36313		Providence St. Pharmacy	Brewer & Co.	0.999
36410	*Shelton:*	Shelton Pharmacy	....	0.952
36253	*Waterbury:*	Apothecaries Hall Co.	Apoth. Hall Co.	0.948
36304		Breas Pharmacy	C. W. Whittlesey	0.951
36306		W. J. Dunphy	Lilly's	0.979
36305		Ebbs Drug Co.	Own make	0.696
36307		The Lake Drug Co.	....	0.851
36149		McCarthy Pharmacy	Apoth. Hall Co.	0.703
36148		W. H. Pickett Drug Co.	Apoth. Hall Co.	0.716
36320	*Willimantic:*	Wilson's Drug Store	....	0.905
36404	*Windsor Locks:*	Bridge Pharmacy	United Drug Co.	0.860
36403		R. J. Keefe Pharmacy	Gibson & Howell	0.983
36345	*Winsted:*	City Pharmacy	....	0.830

GLYCERIN.

Among other specifications given in the Pharmacopoeia for glycerin the specific gravity should not be below 1.249 at 25° C. and the fatty acids and esters in 50 cc should be equivalent to not less than 4 cc of half-normal hydrochloric acid.[1]

[1] U. S. P. X, p. 180

The four samples examined were not labelled as U. S. P. grade but all were reasonably pure. The specific gravities ranged from 1.249 to 1.258 and the fatty acid equivalents ranged from 3.3 to 4.3 cc of half-normal hydrochloric acid.

Compound Solution of Iodine.

This preparation is not the same as the tincture of iodine. The compound solution of iodine, (Lugol's Solution), should contain not less than 4.8 grams nor more than 5.2 grams of iodine and not less than 9.8 grams nor more than 10.2 grams of potassium iodide in 100 cc of the solution.[1] The tincture contains more iodine and less potassium iodide than the compound solution.

Six samples were examined. No. **36414** was tincture of iodine and so labelled (although compound solution was called for), but it contained too little iodine for either the tincture or the solution and the potassium iodide was not correct for either preparation. No. **36335** was low in iodine but a second sample from the same source was substantially correct.

The analyses are given in Table XIII.

Table XIII. Analyses of Compound Solution of Iodine.

No.		Dealer	Iodine gms/100cc	Potass. iodide, gms/100 cc
36341	*Ansonia:*	McQuade Drug Store	4.9	10.1
36414	*Derby:*	Purdy Drug Co. (labeled Tr. Iodine Co.)	3.3	6.7
36127	*Hartford:*	Thomas A. Lynch	4.4	10.1
36335	*Naugatuck:*	A. R. Adams	2.8	10.4
37020		A. R. Adams	4.7	9.7
36142	*So. Norwalk:*	Stillson-Powell Corp.	4.4	10.0

Solution of Iron and Ammonium Acetate.

This preparation should contain not less than 0.6 gram nor more than 0.8 gram of ammonia (NH_3), and not less than 0.16 gram nor more than 0.20 gram of iron (Fe), in 100 cc.

Six samples were examined. One of these, **36128**, was not the article called for but was a different preparation viz., Liquor of Ammonium Acetate, and was so labelled. It was about 2/3 strength for the U. S. P. article of that name. The other samples were satisfactory or were passed as substantially conforming to the requirements.

The analyses are given in Table XIV.

[1] U. S. P., X, p. 217.

TABLE XIV. ANALYSES OF SOLUTION OF IRON AND AMMONIUM ACETATE, ETC.

No.		Dealer	Iron, Fe., gm/100 cc	Ammonia, (NH_3), gm/100 cc
36340	*Ansonia:*	Stever's North End Pharmacy	0.17	0.65
36147	*Fairfield:*	Randall's Pharmacy	0.22	0.61
36128	*Hartford:*	Thomas A. Lynch (Liq. Ammonia Acetate)	none	4.30
36325	*Meriden:*	Pink's Pharmacy	0.22	0.86
36406	*Thompsonville:*	Steel's Corner Drug Store	0.19	0.80
36301	*Waterbury:*	Litsky's Pharmacy	0.20	0.79

HYDRIODIC ACID, DILUTE.

Four samples were submitted by the Dairy and Food Commissioner. One of these, **36434**, was the article called for and was of standard strength, i.e. not less than 9.5 per cent nor more than 10.5 per cent of hydriodic acid.[1] In the cases of **36104** and **36136** there may have been a misunderstanding as to the article demanded because the samples delivered were marked hydrochloric acid (or muriatic acid) ; but one was too strong for dilute hydrochloric acid and the other was about ½ of the standard strength prescribed for that article. In the other case, **36324**, the sample was labelled "hydriodic acid, dilute" but the preparation was hydrochloric acid. We should hope that a physician's prescription calling for hydriodic acid would be more successful in obtaining that article than was the oral request of the inspector.

The dealers from whom samples were purchased are as follows:

36104	*Hartford:*	S. S. Nelson.
36136		M. M. Taylor
36324	*Meriden:*	H. F. Pigeon
36434	*New Britain:*	The Packard Drug Co.

CHLORINATED LIME.

The U. S. P. standard for this product is 30 per cent of available chlorine, but the one sample examined, **36101**, Babbitt's, sold by the Gladding Drug Co., Hartford, was labelled not less than 24 per cent available chlorine. The sample was evidently old stock, at least it contained but 1.5 per cent of available chlorine and was practically worthless as a disinfectant. Chlorinated lime should be packed in air-tight containers and stored in a cool, dry place. There appears to be no commercial package which will preserve this product very successfully.

Inspections made in the past have shown many deficiencies in this product. We have found that packages kept in the laboratory lose from 1 to 3 per cent of chlorine in the period of about two months.[2]

[1] U. S. P. X, p. 18.

[2] Conn. Exp. Sta. Bull. 236, p. 292, 1921.

Mercuric Salicylate.

This preparation should contain not less than 54 per cent nor more than 59.5 per cent of mercury (Hg).[1]

Two samples were examined, both of which were a little in excess of the maximum limit of mercury. Each contained 60.4 per cent. No. **36130** was sold by the Metropolitan Drug Co. of Hartford and No. **36513** was sold by the Central Drug Co. of Bristol.

Mass of Mercury.

Mass of mercury, also known as Blue Mass or Blue Pill, should contain not less than 32 per cent nor more than 34 per cent of mercury (Hg).[2]

Three samples were analyzed. One of these, **36321**, contained substantially the amount of mercury required of the U. S. P. Blue Mass but it was not the official preparation. It was probably powdered Blue Mass.[3]

Analyses are given in Table XV.

Table XV. Analyses of Mass of Mercury.

No.		Dealer	Mercury (Hg), per cent
36137	*Hartford:*	Harry Wynn	34.7
36329	*Wallingford:*	F. W. Marx	32.7
36321	*Willimantic:*	Bay State Drug Co.	35.3

Pepsin, Powdered.

Pepsin is a substance containing a protein-digesting enzyme and is generally obtained from the fresh stomach of the hog. One part of powdered pepsin should digest 3,000 times its own weight of freshly coagulated and disintegrated egg albumen.[4]

In testing for proteolytic activity of pepsin we have found it more convenient to use edestin as the protein substrate instead of egg albumen, interpreting the results in terms of U. S. P. units on the basis of 1:20,000 by the edestin method = 1:30,000 by the U. S. P. method.[5]

Only five samples were examined. All were purchased in bulk. Three of the five were below standard in peptic activity. Assays are given in Table XVI.

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1 U. S. P. X, p. 191.
2 U. S. P., X, p. 235.
3 See U. S. Dispensatory, 20th Ed., p. 688.
4 U. S. P. X, p. 280.
5 Conn. Exp. Station Report 1911, p. 185.

TABLE XVI. ASSAYS OF POWDERED PEPSIN.

No.		Dealer	Peptic activity, (U. S. P. basis).
36102	*Hartford:*	The Gladding Drug Co.	1 : 1500
36103		S. S. Nelson	1 : 6000
36303	*Waterbury:*	Waterbury Drug Co.	1 : 2000
36438	*Watertown:*	Post Office Drug Store	1 : 1500
36439		D. G. Sullivan	1 : 3000

SPIRIT OF PEPPERMINT.
(Essence of Peppermint)

Essence of peppermint should contain approximately 10 per cent of peppermint oil.[1] The one sample, **36895**, submitted contained 12.2 per cent of oil. It was purchased of H. A. King, Chester.

SULPHURIC ACID, AROMATIC.

Aromatic sulphuric contains free sulphuric acid and ethyl sulphuric acid equivalent to not less than 19 per cent nor more than 21 per cent of total sulphuric acid, H_2SO_4.

Seven samples were examined, two of which were considerably below standard.

Analyses are given in Table XVII.

TABLE XVII. ANALYSES OF AROMATIC SULPHURIC ACID.

No.		Dealer	Sulphuric acid, H_2SO_4 %
36417	*Derby:*	Central Pharmacy	16.3
36416		Hyde's Pharmacy	18.2
36105	*Hartford:*	Griswold Drug Co.	15.6
36408	*Shelton:*	E. J. Borden	19.3
36140	*So. Norwalk:*	Clifford Pharmacy	19.2
36145	*Westport:*	Westport Drug Co.	20.0
36318	*Willimantic:*	Wilson's Windham Pharmacy	19.5

THYROID.

Thyroid is the clean, dried and powdered thyroid gland obtained from domesticated animals which are used for food by man. It should contain not less than 0.17 per cent nor more than 0.23 per cent of iodine in thyroid combination and be free from inorganic iodine.[2]

Three samples were examined. They were purchased in bulk and the manufacturers were given as Park, Davis & Co., Armour, and Eli Lilly Co. The products contained 0.39, 0.19 and 0.20

[1] U. S. P. X, p. 355.
[2] U. S. P. X, p. 384.

per cent of iodine respectively. One was double strength and the original package may have been so marked. No statement to that effect was given by the retailer however.

COD LIVER OIL

E. M. BAILEY, HELEN C. CANNON AND H. J. FISHER.

Twenty samples of cod liver oil were examined with reference to a number of chemical constants. They were for the most part Norwegian oils for medicinal use. The Gorton and New Brunswick products were oils for stock feeding, the first named being an American oil. The Napco product was also of American origin. The Isdahl oil was sampled from a shipment of bulk oil, stock of the C. W. Whittlesey Co., New Haven. The New Brunswick sample was from stock of the Frank S. Platt Co., New Haven. The sample of Gorton oil was supplied by courtesy of the Gorton Cod Liver Oil Co. of Gloucester, Mass.

The constants of the oils are given in Table XVIII.

Iodine numbers and saponification values are within the range usually observed for cod liver oil. Unsaponifiable matter is well within the limit prescribed by the Pharmocopoeia (not over 1.5 per cent). The double saponification method was used for this determination.[1] The relatively high acidity noted in sample **5460** is largely, or in part, due to free carbon dioxide with which the oil is saturated.

COLOR TESTS FOR VITAMIN A.

Color reactions observed when the unsaponifiable fraction of cod liver oil is treated with various chemical reagents and the apparent correlation between such reactions and the vitamin potency of the oil, as noted by Drummond[2] and his co-workers, have suggested the possibility of approximately evaluating the vitamin potency of cod liver oils by a relatively simple and rapid test. Wokes and Willimott[3] as a result of their study conclude that color values as determined by their application of the antimony trichloride test afford a reliable index to the vitamin A content of cod liver oil. Notwithstanding these and other studies which indicate the close association or relationship between this vitamin and the chromogenic substances in the oil, there is not enough acceptable evidence at this time to justify the evaluation of cod liver oils with respect to vitamin A on the basis of color reactions.

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1 Official and Tentative Methods of Analysis, A. O. A. C. p. 295.
2 Lancet, 198, 862. 1920.
Biochem. Jour., 19, 753. 1925.
Analyst, 47, 314. 1922.
3 Analyst, 52, 515. 1927.

TABLE XVIII. ANALYSES OF COD LIVER OIL.

).	Brand Name of Oil	Iodine No.	Saponification No.	Unsaponifiable	Free F Acic (calc. Oleic a
				%	%
16	Isdahl & Co....................	167.0	182.4	0.53	0.64
17	Isdahl & Co....................	161.9	182.8	0.48	0.75
18	Isdahl & Co....................	175.7	182.5	0.44	0.66
19	Isdahl & Co....................	167.9	184.3	0.43	0.79
30	Isdahl & Co....................	171.6	182.8	0.41	0.72
31	Isdahl & Co....................	171.2	184.0	0.42	0.65
55	McKesson & Robbins...........	164.3	183.5	0.31	0.79
56	Scott's Blue Seal (Scott & Bowne)	165.5	183.7	0.42	0.66
57	Harris (The Harris Laboratories).	165.4	183.6	0.61	0.59
58	Mead's (Mead, Johnson & Co.) ..	168.7	183.4	0.62	0.54
59	Lofoten (Park-Davis & Co.).....	160.7	184.6	0.45	0.72
60	Squibb's (E. R. Squibb & Sons) ..	159.7	182.4	0.64	1.55
61	Patch's flavored. (E. L. Patch) ..	161.3	182.8	0.93	0.85
62	Peter Mueller's.................	174.2	181.8	0.53	0.51
63	Lofoten (Eli Lilly & Co.)........	164.6	182.4	0.19	0.71
64	Nason's (Tailby-Nason Co.).....	156.7	175.7	0.33	0.67
65	Stone's (Eastern Drug Co.)......	168.1	182.8	0.27	0.75
86	New Brunswick Laboratories....	171.9	182.0	0.12	0.59
87	Gorton's (Gorton's Cod Liver Oil Co.)....................	156.7	183.1	0.18	0.81
38	Nopco (National Oil Products Co.)	158.8	181.0	0.95	0.79

[1] Free CO_2 present.

To determine the correlation, if any, between color reactions, and vitamin A potency as determined in terms of U. S. P. units, a number of these oils were examined.

Color values were first determined by an adaptation of the method as outlined by Carr and Price:[1]

Antimony trichloride was washed with chloroform and dried over sulphuric acid in vacuo. Thirty grams of this washed and dried salt were dissolved so far as possible in 100 cc of chloroform, and after settling the clear solution was used for the tests. Ten grams of oil to be tested were dissolved in, and diluted to 50 cc with, chloroform. For the test 0.2 cc of the oil solution was taken in a test tube, 2 cc of antimony trichloride solution added, the mixture shaken, and the blue color which developed compared at once with the standard before the onset of the transition colors (red and brown), took place. A series of color standards representing arbitrary values of from 1 to 20 was prepared as follows:

One-tenth of a gram of crystal violet and 0.1 gram of methylene blue were each made up to 100 cc with alcohol. One cubic centimeter of the crystal violet solution plus 4 cc of the methylene blue solution were diluted to 250 cc with alcohol. Portions of this solution were taken in amounts of from 0.1 cc to 2.0 cc in intervals of 0.1 cc in a series of test tubes and the volumes in each made up to 2 cc. This series therefore represents an arbitrary color scale of from 1 to 20.

[1] Biochem. Jour. 20, 497. 1926.

All of the samples were tested by this procedure and all found to come within the limits of our scale with three exceptions, values for which were estimated by means of suitable dilutions of the original oil solutions. A summary of the color values obtained is as follows:

Color value of 5 or less	6 samples
Color value of over 5 and not over 10	9 samples
Color value of 10 and not over 15	1 sample
Color value of 15 and not over 20	1 sample
Color value of 20 and over	3 samples

It was found that color values could be checked very closely on repeated tests. It is interesting to observe that the sample of Gaduol, a so-called extract of cod liver oil, which our feeding tests[1] showed to be of very low vitamin A potency, gave a negative test with antimony trichloride.

COLOR TEST FOR VITAMIN D.

Shear's test[2] for vitamin D was tried on a number of samples. By this procedure it was found that cottonseed oil may give a color not readily distinguishable from that produced by cod liver oil, and the green shade mentioned by the author as characteristic of cod liver oil was not observed. Rosenheim and Webster[3] have found that the Shear test is given by substances which are inactive with respect to vitamin D, and also by certain organic peroxides.

FEEDING TESTS FOR VITAMIN A.

Since it was impracticable to conduct feeding trials with all of the twenty samples upon which chemical tests had been made, a limited number were chosen on the basis of their behavior when tested by the antimony trichloride reagent. It was not expected that relatively small differences in color values would be reflected in feeding tests to any measurable extent; but it was thought that the extremes of color values, and possibly some of the intermediate values, might show conspicuous differences in this respect. Accordingly oils were selected which had been evaluated on the color scale at approximately 5, 10, 15, 20, 30 and 70. Although only seven samples were tested some fifty or more separate feeding trials were made extending over a period of several months.

[1] Conn. Exp. Sta., Bull. 276, 283. 1926.
[2] Proc. Soc. Exp. Biol. and Med., XXIII, 546.
[3] Biochem. Jour. XX, 544.

The trials were conducted according to the procedure outlined in the Pharmacopoeia[1] for the assay of cod liver oil for vitamin A and the results are expressed in terms of U. S. P. units. The results are summarized in the following tabulation which gives also the corresponding color values of the oils tested.

Color value of oil (approximate)	Vitamin A value (U. S. P. units)
5	250
5	500
10	250
15	250
20	500
30	500
70	1000

In general, the higher color values are associated with the higher vitamin A potencies. The highest feeding value obtained was with the sample which also showed the highest color value. However, two samples, each with color values of about 5 but having vitamin A values of 250 and 500 respectively, destroy the otherwise reasonably consistent correlation between these two series of tests. It is of interest to note that the highest values for both color intensity and vitamin content were obtained in a sample of American oil intended only for stock feeding purposes.

It has been pointed out in criticism of the U. S. P. assay for cod liver oil that no provision is made for the possible influence of a lack of vitamin D in the basal ration, and that, consequently, the values of vitamin A may not be satisfactorily accurate expressions of potency for this vitamin. The present standard for vitamin A potency *viz.*, 50 units, is regarded by many investigators as too low. From the results obtained by the present method of assay this criticism appears to be justified. However, the standard should not be fixed so high as to lay undue emphasis upon vitamin content. This would tend to result in competition for high vitamin oils with increase in cost and to exclude average oils of acceptable potency. The basal test ration as now recommended would be improved by the addition of vitamin A-free fat or oil. In our experience the present ration is not eaten well by experimental animals, especially when they are in a weakened condition.

The limited series of trials recorded here do not justify general conclusions of a definite character. They lend some support to the already suggested correlation between color reactions and vitamin A potency, but it is premature to conclude that color tests, thus far devised, may be relied upon as indices of relative concentrations of vitamin A, in cod liver oil.[2]

[1] U. S. P., X, p. 469.

[2] Since this work was completed the report of the Accessory Food Factors Committee to the League of Nations Health Organization has been published. Analyst, *53*, p. 156, March, 1928. Their results are substantially in accord with the experience here recorded.

"DENICOTINIZED" TOBACCO.

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Since tobacco cannot be classed either as a food or as a drug the examination of it hardly comes within the scope of food and drug inspection. Its wide-spread use, however, makes it a matter of general interest and its effect upon the health and well being of the consumer is always a fruitful topic for controversial discussion. Those who look with disfavor upon the use of tobacco in any form will find added argument against smoking in the recent work of Neuberg and Ottenstein[1] who have demonstrated the formation of small amounts of wood alcohol during the smoking of cigars and cigarettes.

Because of inquiries, which come to us from physicians and others, regarding the merits of so-called "denicotinized" tobaccos, or tobacco products for which reduced nicotine content is claimed or inferred by label declaration, we have examined as many of these products as we could obtain. Some of these were purchased in the open market, but in most cases manufacturers or distributors have cooperated by submitting samples.

A list of the brands examined, the manufacturers or distributors of them, and the essential claims with respect to ingredient tobaccos and nicotine content, are here given.

7979. *Sano Denicotinized Cigarettes.* The Health Cigar Co., New York. Made from choicest tobaccos grown in Turkey and the United States. Scientifically processed and blended to eliminate the bulk of the nicotine. Endorsed by health institutions and physicians. All that joyous aroma but less nicotine. English blend, mildest of the mild.

7980. *Sano Cigars.* Same manufacturer as above. Contains less than 1% nicotine. Can be safely smoked by those who otherwise could not smoke. Havana filler Sumatra wrapper.

7981. *O-Nic-O Supermild Cigarettes.* Bulk of nicotine removed. Aroma and fragrance retained. Lincoln & Ulmer, Inc., 132 W. 43rd St., New York. Blend of imported and domestic tobaccos.

7982. *O-Nic-O Supermild Cigars.* Lincoln & Ulmer Inc., 132 W. 43rd St., New York. Bulk of nicotine removed. Imported Havana filler, Sumatra wrapper. Absolutely harmless.

7983. *O-Nic-O Supermild Smoking Tobacco.* Lincoln & Ulmer Inc. A superb blend of Havana, Turkish and Virginia tobaccos. Manufactured and processed by Lincoln and Ulmer Inc. Bulk of nicotine removed. Aroma and fragrance retained.

7984. *Sackett Smoking Tobacco Denicotined.* (Bulk of nicotine removed). Fragrance and flavor retained. Supermild. The Bonded Tobacco Co., 1182 Broadway, New York.

7985. *Sackett De-Nicotined Cigars.* (Bulk of nicotine removed). Fragrance of flavor retained. The Bonded Tobacco Company, 1182 Broadway, New York.

7987. *Sackett Denicotined Cigarettes No. 2.* Bulk of nicotine removed. The Bonded Tobacco Co., 1182 Broadway, New York.

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[1] [illegible]

7988. *Sackett Cigarettes De-Nicotined.* A Supermild cigarette. A combination of the finest grades of imported and domestic tobaccos with the bulk of nicotine removed.

7986. *"Dormy" Blue Riband Cigarettes.* Cestrada Cigarette Co., London. R. H. Macy & Co., Inc., New York, Sole Distributors. Finest Turkish. Specially treated for reduction of nicotine.

7990. *"Dormy" Red Riband.* Finest Turkish cigarettes: Specially treated for the reduction of nicotine. Cestrada Cigarette Co., London. R. H. Macy & Co., Distributors.

7991. *Cestrada Virginia de Luxe.* Finest Virginia Cigarettes. Specially treated for reduction of nicotine. Cestrada Cigarette Co., London. R. H. Macy Co., Distributors.

7989. *The Dormy Smoking Mixture.* Cestrada Cigar and Cigarette Co., 23 Pall Mall, London, S. W. I. R. H. Macy & Co., Inc., Sole Distributors.

Bottom of can: *Denicotinised* Tobacco. Specially treated for the reduction of nicotine and other harmful properties.

The usual method by which denicotinized tobaccos are prepared is essentially a resweating process accomplished by treatment with superheated steam or by heating in vacuum chambers. Dixon[1] cites the use of solvents for removing nicotine and other objectionable constituents. It is conceivable also that diluents consisting of non-nicotine-containing leaves foreign to tobacco might be used, but no attempt was made in this investigation to detect the presence of such foreign material.

The terms "processed" and "unprocessed", frequently used in this discussion, refer to the special resweating treatment employed to reduce nicotine content. It is understood of course, that all tobacco undergoes various processes in the course of its preparation for commercial purposes.

It will be noticed that none of these brands are claimed to be nicotine-free. However, such terms as "denicotinized" and "denicotined" will generally be construed to mean "practically free from nicotine", particularly if the further assurance is given, or implied, that the consumer may smoke as much as he likes of these processed tobaccos. To such declarations as "bulk of nicotine removed" or "reduced nicotine content" less objection can be raised; from the first statement we should expect that over one-half of the original nicotine had been removed while any reduction at all in nicotine would suffice to make the second declaration one of fact. The obvious difficulty in judging whether or not these statements are true lies in the lack of information as to the amount of nicotine in the various tobaccos before they were processed. No average figure for the nicotine content of tobacco in general can be given because wide differences occur due to varieties of leaf and varied conditions of culture and growth. There may be substantial differences also among the leaves of the same plant, dark (upper) leaves showing higher nicotine content than leaves lower down on the stalk (lights and seconds).

[1] British Medical Journal, No. 3485, Oct. 1927.

But the consumer is not greatly concerned with the question of whether or not labels are technically correct or exactly descriptive. His interest is to know how these processed tobaccos compare in nicotine content with ordinary tobaccos for which no claims of reduced nicotine are made. There is a considerable amount of data already available which shows the range of nicotine in cured tobacco leaves and in ordinary smoking tobacco, cigars and cigarettes. Some of this is here summarized. The data cited are given on the basis of the moisture-free material.

Twenty-seven samples[1] of tobacco grown in Virginia and North Carolina ranged from 1.68 to 6.17 per cent of nicotine. There were only two showing less than 2 per cent and only five showing more than 5 per cent. The average of all was 3.7 per cent.

Twenty-nine samples[2] of domestic tobacco grown in various parts of the United States ranged from 1.45 to 5.53 per cent and averaged 3.38 per cent. These figures are on the basis of leaves with midrib intact. The average nicotine in the midrib-free leaf, according to the above analyses, was 4.10 per cent. Midribs are removed for the manufacture of chewing tobacco but they may or may not be removed from tobacco prepared for smoking purposes.

Fourteen samples[3] of Havana Seed tobacco ranged from 2.38 to 2.74 per cent and the average of all was 2.59 per cent. These figures are for the entire leaf; without midribs the nicotine content would be somewhat higher.

Howard[4] has analyzed twelve samples of pipe tobacco, cigars and cigarettes, including well-known brands, and found from 1.44 to 3.31 per cent of nicotine. The average being 2.31 per cent. He also examined a number of brands of chewing tobacco, finding from 1.07 per cent to 2.88 per cent.

Thurston[5] gives data upon chewing tobacco, cigars and cigarettes. Four brands of chewing tobacco ranged from 0.98 to 1.50 per cent and averaged 1.14 per cent of nicotine. These figures are on the basis of the material as purchased. Accepting 12 per cent of moisture (as shown by Howard's analyses), as an average water content the average nicotine in the dry material is about 1.30 per cent. Five brands of cigars ranged from 1.26 to 1.73 per cent, averaging 1.52 per cent. Assuming 8 per cent of moisture this average becomes 1.65 per cent in the dry substance. Twenty-five brands of cigarettes contained nicotine in amounts ranging from 0.43 to 3.34 per cent. These figures converted to the moisture-free basis, assuming 8 per cent of water in the samples as purchased, become 0.47 to 3.63 per cent, the average being 1.84 per cent.

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1 Virginia Agr. Exp. Station, Bull. 52, 1895.
2 No. Carolina Exp. Station, Bull. 122, 1895.
3 Conn. Exp. Station, Tobacco Station Bull. 10, 1928.
4 New Hampshire State Board of Health, Quarterly Bull., Jan. 1916.
5 Agr. Commission, Ohio, *Bureau of Drugs, Bull. 2, Nov. 1914.*

Because they furnish data upon some well-known brands of ordinary tobaccos, the analyses of cigarettes as given by Thurston and those of cigars, cigarettes and pipe tobacco as given by Howard, are quoted in Table I.

Table I. Analyses of Ordinary Tobaccos.

Brand	Nicotine As purchased %	Nicotine Moisture-free %
(Cigarettes, analyses by Thurston)		
Nebo	2.03	...
Nebo	1.93	...
Fatima	2.79	...
Hassan	1.94	...
Sweet Caporal	2.05	...
Helmar	1.56	...
Mogul	1.45	...
Egyptian	1.59	...
Omar	1.98	...
Murad	1.52	...
Royal Nestor	1.47	...
Turkish Trophies	1.44	...
Home Run	1.89	...
Home Run	1.67	...
Home Run	1.78	...
Piedmont	3.34	...
Zubelda	1.97	...
La Lucbana	0.43	...
Tareyton	1.75	...
Egyptian Luxury	1.60	...
Fifty-six	1.43	...
Rameses II	1.73	...
Schinasi	1.51	...
Condax	1.06	...
Egyptienne Straights	1.45	...
Egyptian Arabs	1.35	...
Makaroff	1.21	...
Phillip Morris	1.48	...
Maximum	3.34	3.63
Minimum	0.43	0.47
Average	1.69	1.84

TABLE I. ANALYSES OF ORDINARY TOBACCOS (*Concluded*).

Brand	Nicotine As purchased %	Nicotine Moisture-free %
(Cigars, cigarettes and pipe tobacco, analyses by Howard)		
Black Bass, chewing and smoking....	2.46	2.83
B L Light Plug, pipe tobacco........	2.62	2.95
Lucky Strike Plug, pipe tobacco......	1.76	1.93
Main Brace Cut Plug, pipe tobacco...	1.29	1.44
Old English Curve Cut..............	1.94	2.10
Prince Albert......................	1.82	1.99
Tuxedo..........................	2.22	2.36
Seven-Twenty-Four, cigars..........	1.64	1.83
Sweet Caporal Cigarettes............	2.85	3.00
Richmond Straight-Cut No. 1, cigarettes......................	2.79	3.31
Mogul, Egyptian cigarettes..........	1.52	1.64
Mecca, cigarettes..................	2.17	2.33
Maximum..................	2.85	3.31
Minimum..................	1.29	1.44
Average..................	2.09	2.31

In addition to these data recent analyses made in this laboratory are given in Table II. No attempt was made to analyze a large number of brands but rather to include representative types of leaf and the list therefore includes Virginia, Kentucky Burley, Havana, Manilla, Porto Rican, Turkish and various blends. In addition to determinations of total nicotine, the so-called "free" nicotine has been determined as well as certain other items of interest.

TABLE II. ANALYSES OF SOME ORDINARY TOBACCOS.
(Air Dry Basis)

No.	Brand	Water	Total Nitrogen	Nitric Nitrogen	"Ammoniacal" Nitrogen	Organic Nitrogen	Nicotine	"Free" Nicotine	pH value[1]
		%	%	%	%	%	%	%	
8731	Capstan Navy Cut cigarettes	7.68	1.81	0.02	0.20	1.59	2.30	0.26	5.1
8732	Piedmont cigarettes	8.90	2.02	0.05	0.24	1.73	2.89	0.37	5.4
8733	Chesterfield cigarettes	8.60	2.30	0.08	0.24	1.98	2.53	0.45	5.4
8734	Camel cigarettes	8.80	2.46	0.13	0.23	2.10	2.21	0.42	5.5
8735	Old Gold cigarettes	9.60	2.31	0.09	0.25	1.97	2.17	0.43	5.5
8736	Phillip Morris cigarettes	6.25	2.56	0.03	0.22	2.31	1.40	0.17	5.2
8737	Egyptian Deities cigarettes	5.75	2.41	0.00	0.20	2.21	1.28	0.15	5.2
8738	Pall Mall cigarettes	6.17	2.53	0.00	0.23	2.30	1.38	0.14	5.2
8176	Toro, Porto Rican cigarettes	6.96	3.77	0.20	0.50	3.07	1.06	0.37	...
8177	Toro, Porto Rican cigarettes	6.92	3.57	0.23	0.43	2.91	1.08	0.45	...
8178	Lucky Strike cigarettes	8.58	2.34	0.17	0.24	1.93	1.88	0.41	...
8739	Knickerbocker cigars	8.23	3.96	0.00	0.69	3.27	1.90	0.60	6.8
8740	Reyes de Espana cigars	8.55	3.71	0.12	0.27	3.32	1.16	0.79	7.5
8741	Manilla cigars	7.90	3.72	0.00	0.34	3.38	1.31	0.72	7.5
8742	Blue Boar pipe tobacco	11.75	2.39	0.00	0.18	2.21	1.45	0.33	5.9
8743	Weldon Slice (Kentucky Burley leaf)	9.85	2.18	0.16	0.26	1.76	1.84	0.50	5.8
8744	Hudson's Bay Imperial Mixture	12.85	1.59	0.00	0.22	1.37	1.95	0.13	5.1
8745	Gilbert's Mixture	8.83	2.27	0.10	0.24	1.93	2.09	0.45	5.6
	Maximum	12.85	3.96	0.23	0.69	3.38	2.89	0.79	7.5
	Minimum	5.75	1.59	0.00	0.18	1.37	1.06	0.13	5.1
	Average	8.45	2.66	0.08	0.29	2.30	1.77	0.40	5.8

[1] pH value determined on infusion made by mixing 2.5 gm. ground sample with 50 cc distilled water.

TABLE IIA. ANALYSES OF SOME ORDINARY TOBACCOS.
(Water-free Basis)

No.	Brand	Total Nitrogen	Nitric Nitrogen	"Ammoniacal" Nitrogen	Organic Nitrogen	Nicotine	"Free" Nicotine
		%	%	%	%	%	%
8731	Capstan Navy Cut cigarettes	1.96	0.02	0.22	1.72	2.49	0.28
8732	Piedmont cigarettes	2.22	0.06	0.26	1.90	3.17	0.41
8733	Chesterfield cigarettes	2.52	0.09	0.26	2.17	2.77	0.49
8734	Camel cigarettes	2.70	0.14	0.25	2.31	2.42	0.46
8735	Old Gold cigarettes	2.56	0.10	0.28	2.18	2.40	0.48
8736	Phillip Morris cigarettes	2.73	0.03	0.23	2.47	1.49	0.18
8737	Egyptian Deities cigarettes	2.56	0.00	0.21	2.35	1.36	0.16
8738	Pall Mall cigarettes	2.70	0.00	0.25	2.45	1.47	0.15
8176	Toro, Porto Rican cigarettes	4.05	0.21	0.54	3.30	1.14	0.40
8177	Toro, Porto Rican cigarettes	3.84	0.25	0.46	3.13	1.16	0.48
8178	Lucky Strike cigarettes	2.56	0.19	0.26	2.11	2.06	0.45
8739	Knickerbocker cigars	4.32	0.00	0.75	3.57	2.07	0.65
8740	Reyes de Espana cigars	4.06	0.13	0.30	3.63	1.27	0.86
8741	Manilla cigars	4.04	0.00	0.37	3.67	1.42	0.78
8742	Blue Boar pipe tobacco	2.71	0.00	0.20	2.51	1.64	0.37
8743	Weldon Slice (Kentucky Burley leaf)	2.42	0.18	0.29	1.95	2.04	0.55
8744	Hudson's Bay Imperial Mixture	1.82	0.00	0.25	1.57	2.24	0.15
8745	Gilbert's Mixture	2.49	0.11	0.26	2.12	2.29	0.49
	Maximum	4.32	0.25	0.75	3.67	3.17	0.86
	Minimum	1.82	0.00	0.20	1.57	1.14	0.15
	Average	2.90	0.08	0.31	2.51	1.94	0.43

TABLE III. ANALYSES OF SO-CALLED "DENICOTINIZED" TOBACCOS.
(Air Dry Basis)

No.	Brand	Water	Total Nitrogen	Nitric Nitrogen	"Ammoniacal" Nitrogen	Organic Nitrogen	Nicotine	"Free" Nicotine
		%	%	%	%	%	%	%
7979	Sano cigarettes	8.03	2.57	0.07	0.28	2.22	2.51[1]	0.40
8948	Sano cigarettes	11.25	...	...	...	...	2.13[1]	...
7980	Sano cigars	9.50	3.25	0.20	0.68	2.37	1.27	0.44
9570	Sano cigars	11.59	...	...	...	...	0.87	...
7981	O-Nic-O cigarettes	6.54	3.00	0.11	0.25	2.64	1.14	0.20
8892	O-Nic-O cigarettes	6.98	...	...	...	...	0.73	...
8893	O-Nic-O cigarettes	7.65	...	...	...	...	0.95	...
7982	O-Nic-O cigars	9.14	3.46	0.25	0.41	2.80	0.72	0.21
7983	O-Nic-O smoking tobacco	11.71	2.64	0.10	0.22	2.32	0.97	0.21
7984	Sackett smoking tobacco	10.85	2.60	0.10	0.24	2.26	0.98	0.18
7985	Sackett cigars	9.06	3.37	0.16	0.34	2.87	0.67	0.18
7987	Sackett cigarettes No. 2	9.41	2.73	0.07	0.25	2.41	1.07[2]	0.20
7988	Sackett cigarettes	7.18	2.60	0.01	0.20	2.39	1.07	0.13
7986	Dormy Blue R. Turkish cigarettes (Cestrada)	6.80	2.62	0.04	0.21	2.37	1.19	0.15
7990	Dormy Red R. Turkish cigarettes (Cestrada)	6.87	2.64	0.03	0.21	2.40	1.19	0.19
7991	Cestrada Virginia cigarettes	6.67	1.68	0.04	0.14	1.50	2.10	0.33
7989	Dormy smoking tobacco (Cestrada)	10.26	2.50	0.07	0.23	2.20	2.26	0.28
	Maximum	11.71	3.46	0.25	0.68	2.80	2.51	0.44
	Minimum	6.54	1.68	0.01	0.14	1.50	0.67	0.13
	Average	8.79	2.74	0.10	0.28	2.37	1.28	0.24

[1] The manufacturer advises that a new denicotinizing process is about to be put into operation. ımples of the new product could not be secured in time to include analyses in this report.

[2] Duplicate sample analyzed later contained 0.97 per cent nicotine.

TABLE IIIA. ANALYSES OF SO-CALLED "DENICOTINIZED" TOBACCOS.
(Water-free Basis)

No.	Brand	Total Nitrogen	Nitric Nitrogen	"Ammoniacal" Nitrogen	Organic Nitrogen	Nicotine	"Free" Nicotine
		%	%	%	%	%	%
7979	Sano cigarettes	2.79	0.08	0.30	2.41	2.73[1]	0.43
8948	Sano cigarettes	...	...	...	...	2.40[1]	...
7980	Sano cigars	3.59	0.22	0.75	2.62	1.40	0.48
9570	Sano cigars	...	...	...	...	0.98	...
7981	O-Nic-O cigarettes	3.21	0.12	0.27	2.82	1.22	0.21
8892	O-Nic-O cigarettes	...	...	...	...	0.78	...
8893	O-Nic-O cigarettes	...	...	...	...	1.03	...
7982	O-Nic-O cigars	3.81	0.28	0.45	3.08	0.79	0.23
7983	O-Nic-O smoking tobacco	2.99	0.11	0.25	2.63	1.10	0.24
7984	Sackett smoking tobacco	2.92	0.11	0.27	2.54	1.10	0.20
7985	Sackett cigars	3.71	0.18	0.37	3.16	0.74	0.20
7987	Sackett cigarettes No. 2	3.01	0.08	0.28	2.66	1.18	0.22
7988	Sackett cigarettes	2.80	0.01	0.22	2.57	1.15	0.14
7986	Dormy Blue Riband Turkish cigarettes (Cestrada)	2.81	0.04	0.23	2.54	1.28	0.16
7990	Dormy Red Riband Turkish cigarettes (Cestrada)	2.83	0.03	0.23	2.58	1.28	0.20
7991	Cestrada Virginia cigarettes	1.80	0.04	0.15	1.61	2.25	0.35
7989	Dormy smoking tobacco (Cestrada)	2.79	0.08	0.26	2.45	2.52	0.31
	Maximum	3.81	0.28	0.75	3.16	2.73	0.48
	Minimum	1.80	0.01	0.15	1.61	0.74	0.14
	Average	3.00	0.11	0.31	2.59	1.41	0.26

[1] See note Table III.

Analyses of "denicotinized" tobaccos are given in Table III.

By combining the data upon ordinary tobacco as given in Tables I and IIA, also that upon "denicotinized" products as given in Table IIIA, giving due weight to the number of samples analyzed by the several investigators in the case of the unprocessed products, we have the following comparative summary:

	Nicotine in Ordinary Tobaccos, moisture-free. (58 analyses)	Nicotine in "Denicotinized" Tobaccos, moisture-free. (17 analyses)
	%	%
Maximum	3.63	2.73
Minimum	0.47	0.74
Average	1.96	1.41

From this summary it is clear that, on the basis of averages, these "denicotinized" products, as a group, contain about 30 per cent less nicotine than is likely to be found in ordinary unprocessed tobaccos. If we may assume 2 per cent as a fair approximation of the average nicotine content (dry basis), which may be expected in the various forms of ordinary smoking tobaccos, a reference to Table IIIA shows that four "denicotinized" samples contain more than this average and that four contain less than one-half as much. For the remainder it seems fair to conclude that approximately 1/3 to 1/2 of the original nicotine has been removed.

It is of interest to compare these processed tobaccos so far as possible with ordinary tobaccos of corresponding types on the basis of nicotine content, assuming as fairly representative nicotine values 2.5 to 3.5 per cent for Virginia tobacco, 2.0 to 3.0 per cent for various other domestic leaf, 1.1 to 2.4 per cent for Havana, and 1.0 to 1.5 for Turkish.

7979. *Cigarettes.* Claimed Turkish and Domestic. Nicotine found 2.6 per cent.[1] Compare Turkish 1.0 to 1.5, and domestic 2.0 to 3.0 per cent.

7980. *Cigars.* Claimed Havana filler and Sumatra wrapper. Nicotine found 1.2 per cent.[1] Compare Havana 1.1 to 2.4 per cent.

7981. *Cigarettes.* Claimed imported and domestic. Nicotine found 1.0 per cent.[2] Compare Turkish 1. to 1.5, Havana 1.1 to 2.4, domestic 2.0 to 3.0.

7982. *Cigars.* Claimed Havana filler, Sumatra wrapper. Nicotine found 0.8 per cent. Compare Havana 1.1 to 2.4 per cent.

7983. *Pipe Tobacco.* Claimed Havana, Turkish and Virginia. Nicotine found 1.1 per cent. Compare Havana 1.1 to 2.4, Turkish 1.0 to 1.5, and Virginia 2.5 to 3.5 per cent.

7984, 7985, 7987. Ingredient tobaccos not stated. Nicotine found 1.1, 0.7, and 1.2 respectively.

7988. *Cigarettes.* Claimed imported and domestic. Nicotine found 1.2 per cent. Compare Havana 1.1 to 2.4, Turkish 1.0 to 1.5, and domestic 2.0 to 3.0 per cent.

7986, 7990. *Cigarettes.* Claimed Turkish. Nicotine found 1.3 per cent in each brand. Compare Turkish 1.1 to 1.5 per cent.

7991. *Cigarettes.* Claimed Virginia. Nicotine found 2.3 per cent. Compare Virginia 2.5 to 3.5 per cent.

7989. *Pipe tobacco.* Ingredient tobaccos not stated. Nicotine found 2.5 per cent.

[1] Average of two samples.
[2] Average of three samples.

Another comparison may be made on the basis of the classes of products examined. The unprocessed cigarettes, as shown by analyses in Table IIA, have a range of nicotine content from 1.1 to 3.2 per cent whereas "denicotinized" cigarettes range from 1.2 to 2.7 per cent. Pipe tobacco, unprocessed, ranges from 1.6 to 2.3 per cent as compared with 1.1 to 2.5 per cent for the denicotinized article. The data on cigars is rather limited but the range is 1.3 to 2.1 for ordinary cigars and 0.7 to 1.4 for processed cigars.[1]

From these data it is quite obvious that, in general, the denicotinized products here represented contain but little less nicotine than do ordinary tobaccos of corresponding leaf types. Notwithstanding considerable reductions which may be indicated in certain instances, it is not difficult to find among ordinary tobaccos brands in which nicotine is not greatly in excess of that present in the most thoroughly processed of these denicotinized products.

While it is not the purpose of this study to discuss the merits or demerits of "denicotinized" tobacco it may be noted in passing that these processed products are quite likely to be used in such a way as to defeat the purpose for which they are intended. Granting the deleterious effects of nicotine, this substance is not the only constituent of tobacco reputed to be injurious to health, but it is, on the other hand, generally regarded as an important, if not the chief, factor contributing to the satisfying effects which are derived from smoking. It seems reasonable to anticipate then that the consumer having recourse to denicotinized tobacco as a means of reducing his customary nicotine ration will consume more of such tobacco, partly because he believes it to be largely or entirely freed from its objectionable nicotine and partly also, if the tobacco is greatly reduced in nicotine, in an unconscious effort to secure the satisfying effects which he is accustomed to derive. Consequently, by reason of his increased indulgence, his actual nicotine intake may equal or exceed his usual consumption.

FREE NICOTINE.

Another feature of this work upon tobacco is of quite as much interest as the comparisons of total nicotine content. Garner[2] has observed that nicotine in the tobacco leaf is, or may be, of two types, the one combined with the organic acids of the leaf and the other free, or very loosely combined. This "free" nicotine he found to be readily volatile and, moreover, easily extractable with solvents, notably petroleum ether. He further showed that if the tobacco were first treated with an organic acid, citric acid for example, this nicotine became fixed and yielded very little to petroleum ether thereafter.

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[1] Howard, Loc. cit., reports 1.54 per cent nicotine in *Girard* cigars, (denicotinized), Manfr. Roig & Langsdorf, Phila.

[2] U. S. Dept. Agr., Bur. Plant Ind., Bull. 141. 1909.

With these observations in mind it seemed quite probable that the denicotinizing processes would serve to remove only that portion of the nicotine which was free or in a loosely combined state, and that, consequently, denicotinized tobaccos would show very little, if any, free nicotine. The following summary taken from Tables IIA and IIIA however shows that such is not the case. There is no very significant difference between the ordinary tobaccos and the denicotinized products as regards their free nicotine content.

	Free Nicotine	
	Ordinary tobaccos	Denicotinized tobaccos
	%	%
Maximum	0.86	0.48
Minimum	0.15	0.14
Average	0.43	0.26

In some preliminary experiments it was found, in confirmation of Garner's experience, that free nicotine can be substantially reduced by treating tobacco with citric acid. Free nicotine as that term is used here is that which is liberated from tobacco by distillation with steam without previous treatment with alkali, nicotine being determined in the distillate by precipitation with silicotungstic acid as in the determination of total nicotine. The treatment with citric acid did not serve to hold all of the nicotine in combination; from 0.14 to 0.26 per cent of free nicotine was found after such treatment. Oxalic acid was found to be somewhat more effective, but again some free nicotine was found, 0.09 to 0.14 per cent. On treatment with sulphuric acid, however, no free nicotine could be recovered. This experience suggested that the nicotine salts of the organic acids in the leaf are dissociated to a greater or less extent depending upon the acid strength of the leaf fluids. It was found that the pH value of the sulphuric acid which held nicotine completely in combination was 3.7 whereas the oxalic acid used in the experiment cited had a pH value of 4.7 which degree of acidity was insufficient to hold all of the nicotine in combination. A survey of the results for free nicotine and for the corresponding pH values as given in Table II, shows in general, and with as much consistency as may reasonably be expected under the conditions of the experiment, that with decreasing hydrogen ion concentrations increasingly greater amounts of free nicotine are obtained. As might be expected the highest percentages of free nicotine are observed in those instances where the pH values approach 7.0. With this explanation of the occurrence of free nicotine there appears to be no reason to expect any conspicuous difference in this respect be-

tween ordinary and denicotinized tobaccos. Whatever free nicotine may be removed in the treatment is replaced by further dissociation of the remaining nicotine salts.

The harsh, irritating effects experienced in smoking certain tobaccos are attributed largely, or in part, to the presence of free nicotine. The data here presented indicate no conspicuous advantage of denicotinized products over ordinary tobaccos in this respect.

NITROGEN DISTRIBUTION.

It is interesting to note that the denicotinizing process has effected no change in the nitrogen distribution in the tobaccos so far as are indicated by the several nitrogen partitions determined. The summaries for the two classes of products are practically identical. Nitrate nitrogen is low and quite in contrast with the amounts which are found in tobacco grown with liberal applications of nitrogenous fertilizers.[1] Ammoniacal nitrogen is also lower than is found in leaf grown under the conditions just noted. The values given for this nitrogen fraction are enhanced somewhat by nicotine which distills over under the conditions of the method used and is evaluated as ammonia. The low nitrate nitrogen content of both classes of tobaccos does not support the opinion sometimes expressed that smoking tobaccos are "nitrated" to enhance burning capacity.

CONCLUSIONS.

Seventeen samples of "denicotinized" tobaccos have been compared with ordinary tobaccos with reference to total nicotine, free nicotine and nitrogen distribution.

The "denicotinized" products vary considerably in nicotine content as do ordinary tobaccos. As a group, they were found to contain somewhat less nicotine than tobacco not specially processed, the comparison being based upon averages for each of the two classes.

Some denicotinized products contained as much nicotine as is likely to be found in ordinary tobaccos; a few contained substantially less.

The lowest nicotine content found in any sample was about 0.75 per cent. The lowest value for ordinary tobacco, quoted from analyses made elsewhere, is about 0.50 per cent but this is probably unusual; however, certain types of tobacco, Havana, Porto Rican and Turkish for example, may contain normally as little as 1 per cent of nicotine.

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[1] Conn. Exp. Sta., Tobacco Station Bull. 10, 1928.

None of the "denicotinized" tobaccos included in this investigation are sufficiently low in nicotine to warrant unrestricted indulgence on the part of consumers who suffer ill effects from this alkaloid.

It may be found to be commercially possible to make the removal of alkaloid from tobacco practically complete as has been done in the case of coffee for example; but whether the finished product will retain any of the qualities for which tobacco is prized for smoking purposes is an obvious question.

No attempt has been made in this study to determine whether reduction in nicotine has been accomplished entirely, or in part, by the use of fillers.

Free nicotine appears to be due to the dissociation of the nicotine salts of the organic acids in the tobacco leaf. The harsh and irritating effects experienced when smoking certain tobaccos are attributed to this form of nicotine. Denicotinized tobaccos do not differ in any conspicuous degree from ordinary tobaccos in this respect.

Nitrogen in the form of nitrates and of "ammonia" are practically identical in both classes of tobaccos. The amount of nitrate found does not indicate that tobaccos are nitrated to improve burning capacity.

MISCELLANEOUS MATERIALS EXAMINED FOR POISONS, ETC.

The following materials, fifty-five in number, have been submitted by the Dairy and Food Commissioner, by health officials, police departments, physicians or others interested, to be examined for poisons or deleterious substances or for other purposes.

6181. *Antifreeze Solution* said to be "Hygenite". Sample had an odor of iodoform. It was a solution of calcium chloride colored with a chromium compound.

7580, 7581. *Beer.* Submitted by Police Department, Westville. No evidence of narcotic drugs was found.

7658, 7659. *Beets, Canned,* discolored. No poisons identified but the odor raised doubt as to their fitness for food and the owner was advised not to eat them.

7486. *Boned Chicken, Canned.* Presence of other meat, particularly veal, suspected. Product appeared to be as labelled but no opinion as to presence of other meats could be given.

7677. *Cherry Jelly.* Tests for cyanides and for arsenic negative.

7570. *Chicken carcass.* Owner had lost many chicks and suspected poison. No poison was found. Epidemic disease probably responsible for losses.

7522. Similar complaint as in case of 7570. No evidence of poison found.

37113. *Dr. Fugate's Asthma and Hay Fever Remedy.* Submitted by the Dairy and Food Commissioner.

Analysis (grams per 100 cc.) Solids 4.87; ash 4.48; iodine 3.17; potassium oxide 1.31; arsenic, as trioxide, 0.04; ether present, not determined. Alcohol 19 per cent by volume. Potassium iodide calculated from iodine 4.2, calculated from potassium oxide 4.6 gms per 100 cc. Contained traces of chlorides and carbohydrate. Alkaloids none or trace.

36764. *Ex Lax.* No evidence of any medicament other than phenolphthalein. This was evidently mixed with a chocolate base.

8086. *Fibers from rug.* Fibers were charred and were strongly acid. Sulphates present. Warp fiber not found but wool fibers were intact. Damage evidently caused by sulphuric acid.

7785. *Food*, etc. Submitted by Police Department of Bridgeport. Numerous articles of food suspected of having caused illness. Nothing suspicious was found on examination.

7467. *Food*, 7468 and 7469, *Stomach contents and organs of two dogs.* Submitted by the Commissioner on Domestic Animals. Strychnine was found in the food and in the organs of the dogs. Identified by chemical and by biological tests.

34796, 34797. *Ginger Ale.* Submitted by the Dairy and Food Commissioner. The samples had no suspicious odor or taste and no evidence of deleterious substances was found.

7939, 7940. *Medicine*, said to have caused unfavorable symptoms and a mistake in compounding the prescription was suspected. Prescription called for Nux Vomica, Gentian and Neurophosphates. Samples as submitted were of different intensity of color which was ground for suspicion on the part of the patient. The greenish color of the solution was due to the neurophosphate constituent and not to the Nux Vomica. Strychnine was present in both samples, the total alkaloid content was substantially the same in both, and there was no conclusive evidence that the dose of alkaloid was in marked excess of that called for by the prescription or that recognized in the U. S. P. as an average dose.

7607. *Milk.* Suspected of having been tampered with, contained 1.03 per cent of alcohol.

37431. *Olive Oil.* Thought to have caused illness. Sample was free from adulterants and no evidence of deleterious ingredients was found.

7778. *Oysters.* Gas was being given off in the sample as received. No putrid odor but a "sour" odor was noted. Their fitness for food was questioned.

7245. *Ointment.* Formula called for salicylic acid, sulphur and petrolatum. No excess of sulphur was found.

37011, 37012. *Oil of Sweet Almond.* Samples conform satisfactorily with standard prescribed for this material and no evidence of foreign substances was found.

36801. *Oil of Wintergreen.* Sold for wintergreen extract. Submitted by Dairy and Food Commissioner. Practically pure methyl salicylate (or oil of wintergreen), by U. S. P. assay. Poisoning from oil of wintergreen is not frequent but it does occur and as a medicine it should be taken only on advice of a physician. The extract used for flavoring purposes contains only 3 per cent of the oil.

37036. *Prescription.* The medicine had a pronounced odor or ammonia and the patient suspected an error in the prescription or in compounding. The prescription called for eight items of medicament, among them magnesium oxide and a proprietary remedy "Neurosine". Examination of the Neurosine used showed the presence of an ammonium compound and of bromides. It contained no free ammonia but 1.1 gms. per 100 cc were liberated on boiling with magnesium oxide. The prescription itself yielded 0.43 gm. per 100 cc on boiling without addition of magnesium oxide. The free ammonia in the

medicine was due to the action between two of the ingredients called for in the prescription viz., magnesium oxide and the ammonium compound contained in Neurosine. The dosage of ammonia when taking the medicine according to the directions given was about 1/25 of a gram or less than ½ that contained in the average dose of 10 per cent ammonia water according to the U. S. P., X and about the same as that of the recognized dose of aromatic spirits of ammonia. The quantity of ammonia liberated in this instance cannot be regarded as dangerous but the practice of prescribing "patent" medicines together with other medicaments, particularly when compounded together, is not therapeutically sensible and is open to serious criticism.

8083. *Pyramidon Tablets.* Five grain tablets. Submitted by Dr. Silverberg, New Haven. Patient had shown symptoms not noted upon former administrations of the same medicament. The tablets weighed 5.56 grains each and the percentage of pyramidon found was 85.53 making a dosage of 4.76 grains which was not in excess of the declared dose.

7743. *Rubbing Solution,* said to be used for hernia and for strengthening muscles, etc. Sold by an itinerant vendor whose present whereabouts was unknown to the purchaser. Solution was a dilute alcoholic fluid containing methyl salicylate with probably a little eucalyptol, menthol and thymol.

8029. *Salve.* Supposed to contain nutgalls and opium. Tannic acid was present in quantity, and hence probably nutgalls; but no evidence of opium was found.

31609. *Sausage.* Submitted by the Dairy and Food Commissioner. (Bacteriological examination made by State Board of Health). No evidence of metallic poisons found.

8064. *Shampoo Soap.* Thought to have caused falling hair. A palm oil or cocoanut oil soap solution containing a little alcohol but no free alkali. No appreciable extraneous material found.

7780. *Stomach contents* and organs of a dog. Submitted by Dr. DeVita, New Haven. No evidence of alkaloids or of metallic poisons was found.

7714. *Stomach contents* of dog. Submitted by Commissioner on Domestic Animals. No evidence of poisons found.

7069. *Stomach contents* of dog. Found to contain about ½ grain of barium soluble in dilute acid and about ¼ grain of insoluble barium. Soluble barium is a poison but it is sometimes administered by veterinaries as a purgative.

8084. *Stomach contents* etc. of dog. No alkaloidal or metallic poisons found.

7377, 7378, 7379 *and* 7380. *Stomach contents* of cows. Submitted by Commissioner on Domestic Animals. Suspected arsenic poisoning. No arsenic was found.

6519. *Stomach contents* of cow. No evidence of poison found.

6685. *Vanishing Cream.* Examined for potassium (0.34%), and sodium (0.09%).

6178. *Vegetable powder* for identification. Found to contain large amount of ground caraway seed and some ginger. Could not identify as corresponding to any complete U. S. P. or N. F. formula.

6833. *Viscera of chicks.* No poisons were detected.

34423. *Weatherup's Germ Destroyer,* Nos. 1 and 2. The medicament in both these articles is absorbed upon cotton in small vials. No. 1 is to be inhaled through the nose, and No. 2 through the mouth. The "germ destroyer" is, or resembles, a mixture of mustard oil and kerosene. The odor is extremely pungent and irritating, particularly No. 1, and both should be inhaled with caution.

6303. *White Blotting Paper.* Used for germination tests. No mineral impurities found excepting traces of chloride and sulphate.

6384, 6385, 6386, 6387. *Wine, cider and beer,* and a piece of hose used as a siphon to remove beverages from kegs. Submitted by the State Board of Health in connection with a case of lead poisoning. Less than 1 part of lead per million was found in the wine and in the cider. None was found in the beer. The hose contained about 1.9 per cent. of lead.

7762, 7763, 7764. *Wine, Mineral water and a bottle containing residue* of white powder. No evidence of poisons found. The white powder was magnesium carbonate.

WATER ANALYSES FOR STATE WATER COMMISSION.

Seventeen samples of water have been submitted by Mr. Copeland, engineer to the State Water Commission, for chemical examination. Reports have been made to the Commission in all cases and no discussion is called for in this report. Methods of the American Public Health Association are employed in this work wherever such are applicable.

DAIRY GLASSWARE.

The station is required to check the calibration of all pipettes, milk test bottles and cream test bottles used in the State for the testing of milk and cream by the Babcock method. Since July 1, 1927 the station has also been required to test thermometers which are to be used in pasteurizing plants for checking recording thermometers.

The following table summarizes work of this sort which has been done during the past year.

GLASSWARE EXAMINED.

	Total	Broken	Accurate	Inaccurate
Cream test bottles	369	2	341	26
Milk test bottles	2055	1	2017	37
Pipettes	442	17	424	1
Thermometers	229	3	216	10
Totals	3095	23	2998	74

INDEX

Ammonia water, 325; analyses of, 325
Amyl nitrite, 325
Babcock glassware, 354
Borax, 325
Bread:
  Thomas Gluten, 312
  Linn's Vitamin Whole Wheat, 312
  Unleavened, 312
Butter, 315
Cacao products, 310, 311
Calcium hydroxide, solution of, 326; analyses of, 326
Carbonated beverages, 310
Carbon tetrachloride, 325
Cereal products, 312
Cheese, 314
Cod Liver Oil, 334; analyses of, 335; feeding tests on, 336; color tests for, 334, 336
Cottonseed oil, 316
Cream of tartar, 326
Cresol, comp. solution of, 326
Diabetic foods, 312; analyses of, 313
"Denicotinized" tobacco, 338
Drugs, 325
Eggs, 314
Ethyl nitrite, Spirit of (Sweet Spirit of Nitre), 327; analyses of, 327
Fats and Oils, 315
Ferrous carbonate, mass of, 328; analyses of, 329
Ferric chloride, solution of, 328; analyses of, 328
Fowler's solution, 329; analyses of, 329
Fruits and Fruit products, 316
Glassware, dairy, 354
Glycerin, 329
Honey, 320; analyses of, 321
Hydriodic acid, dilute, 331
Ice cream, 317
Iodine, comp. solution of, 330; analyses of, 330
Iron and ammonium acetate, 330; analyses of, 331
Lime, chlorinated, 331
Lime water, 326; analyses of, 326
Maple syrup, 322
Meat products, 317
Mercury, mass of, 332; analyses of, 332
Mercuric salicylate, 332
Milk and milk products, 318
Milk, human, 318
  evaporated, 318
Miscellaneous materials examined for poisons, 351
Olive oil, 316
Oysters, 319
Pepsin, powdered, 332; analyses of, 333
Peppermint, spirit of, (Essence of peppermint), 333
Pickles, 319
Poisons, materials examined for, 351
Salad dressing, 319
Special foods, 312; analyses of, 313
Sulphuric acid, aromatic, 333; analyses of, 333
Tea, 322
Thyroid, 333
Tobacco, denicotinized and ordinary, analyses of, 341 *et seq.*
Tomato catsup (ketchup), 322, 323; analyses of, 324
Vinegar, 323
Vitamins A and D, color tests for, 334, 336
  A, feeding tests for, 336
Water analyses, 354

INDEX

to

Report for 1927

Note—The page numbers with the prefix T refer to the Reports of the Tobacco Substation, which immediately follow this index.

PAGE

Abbot sphinx.......... 207
Acronycta rumicis.......... 222
Adelges abietis.......... 207, 211, 214
pinicorticis.......... 207
strobilobius.......... 207
Agrilus viridis var. *fagi*.......... 222
Alsophila pometaria.......... 200, 204
American Agricultural Chemical Co. fertilizers
3, 7, 18, 19, 22, 23, 27, 28, 38, 40, 41, 42, 43, 44, 48, 49, 52, 54, 62, 64, 78, 82, 83.
Cyanamid Co. fertilizers.......... 8
Ammonia water.......... 325
analyses of.......... 325
Ammonium Sulphate.......... 18
analyses of.......... 20
Amyl nitrite.......... 325
Anastatus bifasciatus.......... 243
Ancylis comptana.......... 208, 269
Anomala orientalis.......... 197, 209, 288
Anuraphis roseus.......... 198, 296
Aphids and weather conditions.......... 271
Aphis pomi.......... 198, 276, 296
Apiary inspection.......... 223
Aporia crataegi.......... 223
Apothecaries Hall Co. fertilizers
8, 18, 19, 22, 23, 35, 36, 38, 40, 41, 42, 43, 48, 49, 52, 53, 54, 64, 82
Apple and thorn skeletonizer.......... 126, 200
aphid, green.......... 198, 296
rosy.......... 198, 296
woolly.......... 199
bucculatrix.......... 200
leafhopper.......... 199
maggot.......... 201
spraying and dusting.......... 256
tree borers.......... 131
Arborvitae leaf-miner.......... 161
Armour Fertilizer Works, 8, 18, 19, 23, 28, 38, 40, 41, 42, 43, 48, 49, 52, 54, 64
Arundinaria sp.......... 297
Ashcraft-Wilkinson Co. fertilizers.......... 3, 9, 27, 29
Asiatic beetle.......... 197, 209
control work.......... 288
Asparagus beetles.......... 202
Aspidiotus perniciosus.......... 199
Asterolecanium variolosum.......... 206
Atlantic Packing Co. fertilizers.......... 9, 64
Babcock glassware.......... 354
Bacillus larvae.......... 225
pluton.......... 225

PAGE

Baker Castor Oil Co. fertilizers....9, 22, 23, 24
Bantle, E. J. fertilizers.... 9, 66
Barrett Co. fertilizers.... 9, 18, 20
Bartlett, F. A. Tree Expert Co. fertilizers.... 9, 66
Beech woolly aphid.... 151, 207
Berkshire Chemical Co. fertilizers
9, 18, 19, 22, 25, 35, 36, 38, 41, 42, 43, 48, 49, 52, 54, 66, 78, 82
Birch leaf miner, imported....143, 197, 205
skeletonizer....144, 197, 205
Blackberry psyllid.... 298
cherry aphid.... 136
Blister beetle, margined.... 203
Bone Phosphate.... 35
analysis of.... 36
Borax.... 325
Boxwood leaf miner.... 162, 208
Brachyrhinus sulcatus.... 208
Bread.... 312
Bridge's Amos D. Sons, Inc. fertilizers.... 9, 66
Bristle tail.... 209
Brode, F. W. Corp. fertilizers....3, 9, 27, 29, 30
Bronze birch borer.... 147
Bucculatrix canadensisella.... 197, 205
pomifoliella.... 200
Bud moth.... 200
Butter.... 315
Cabbage maggot.... 203
worm, green.... 203
Cacao products.... 310, 311
Calcium hydroxide, solution of.... 326
analyses of.... 326
nitrate (Nitrate of Lime) analyses of.... 21
Calophasia lunula.... 223
Calosoma scrutator.... 200, 262
Cankerworms.... 120
in New London County.... 261
fall.... 200, 204
Carbonated beverages.... 310
Carbon tetrachloride.... 325
Carpocapsa pomonella.... 200
Carrot rust fly.... 203, 278
Case, A. H. & Co., Inc., fertilizers.... 9, 78, 82
Castor Pomace.... 22
analyses of.... 23
Catalpa bungei.... 212
Cecropia caterpillar.... 156
Celery leaf-tyer.... 298
Ceratophyllus gallinae.... 209, 279
Cereal products.... 312
Chalepus dorsalis.... 206
Changes in Station staff.... 105
Cheese.... 314
Cherry aphid.... 199
black.... 136
Chionaspis pinifoliae.... 207
Chittenden, E. D. Co., The, fertilizers 10, 18, 19, 22, 25, 38, 52, 54, 56
Cicada periodical.... 297
Clark, Everett B. Seed Co. fertilizers....10, 18, 19, 38, 66

PAGE
Clethra alnifolia 212
Climbing cutworms 130
Cod Liver Oil 334
analyses of 335
color tests for 334, 336
feeding tests on 336
Codling moth 200
Coleophora limosipennella 205
Columbine leaf-miner 168
Commercial Deficiencies, table of 59
Conn. Fat Rend. & Fertilizer Corp. fertilizers 10, 52, 53
Conotrachelus nenuphar 197, 200
Consolidated Rendering Co., fertilizers
10, 11, 18, 19, 22, 25, 27, 28, 38, 40, 41, 42, 43, 48, 49, 52, 53, 54, 78, 82
Contarinia pyrivora 201
Convention of entomological workers 209
Corn borer, European, control work 246
quarantine 252
ear worm 203
maggot, seed 203
seed, inspection 221
Cornus florida 298
Cottonseed Hull Ashes 11,41
analyses of 44
Meal 3, 27, 28
analyses of 28
oil 316
—wood leaf beetle 145
Cottony maple scale 153
Cream of tartar 326
Crepidodera helxines 212
Cresol, comp. solution 326
Crioceris asparagi 202
12-*punctata* 202
Cryptorhynchus lapathi 206, 297
Cucumber beetle, striped 202
Currant aphid 136, 199
Cutworms 169, 201
climbing 130
variegated 201
Cyclamen mite 172, 208
Datana ministra 200
Davey Tree Expert Co. fertilizers 10, 66, 82
"Denicotinized" tobacco 338
Derris 277
Diabetic foods 312
analyses of 313
Diabrotica vittata 202
Dichomeris marginellus 207
Diprion simile 205, 212
Drugs 325
Dry Ground Fish 48
analyses of 49
Eastern States Farmers' Exchange fertilizers 10, 11, 18, 19, 20, 38, 40, 43, 54, 68
tent caterpillar 124
Eggert, Ed. fertilizers 11, 41, 44, 45
Eggs 314
Eight-spotted forester 157

	PAGE
Elm case bearer, European	205
leaf beetle	144, 205
scale	206
scurfy scale	154
Emphytus cinctus	223
Empoa rosea	199
Empoasca mali	199
Ennomos subsignarius	200
Epicauta marginata	203
Eriocampoides limacina	201
Eriophyes pyri	199
Eriophyid mites	159
Eriosoma lanigerum	199
Essex Fertilizer Co. fertilizers	11, 68
Ethyl nitrite, Spirit of (Sweet Spirit of Nitre)	327
analyses of	327
Eulia velutinana	200
Euonymus scale	159
Euproctis chrysorrhoea	223
European elm case bearer	205
scale	153
fruit lecanium	123
pine shoot moth	162
red mite	140
Fall webworm	120
Fats and Oils	315
Feltia venerabilis	202
Fenusa pumila	197, 205
Ferric chloride, solution of	328
analyses of	328
Ferrous carbonate, mass of	328
analyses of	329
Fertilizer, check samples	87
law, provisions of	3
Fertilizers, analyses of mixed	57
classification of samples analyzed	17
containing nitrogen and phosphoric acid analyses of	57
potash	47
phosphoric acid and potash	57
ammonia and potash analyses of	62
gratuitous analyses of	6
inspection of	17
precautions to be observed in drawing samples of	5
Field slug, gray	203
Foul brood, American	225, 230
European	225, 230
Ford Motor Co. fertilizers	11, 18, 20
Four-lined plant bug	172
Season Fertilizer Co., Inc., fertilizers	11
Fowler's solution	329
analyses of	329
Frisbie, L. T. Co. fertilizers	11, 52, 54, 68
Fruit insects	198
scale, European	201
worm, green	200
Fruits and Fruit products	316
Galerucella xanthomelaena	205

PAGE

Garden flea hopper ... 203
slugs ... 170
spring-tail ... 169
Germination standards for vegetable seeds ... 184
Gillettea cooleyi ... 207, 211, 213, 214
var. *coweni* ... 207
Gipsy moth ... 122, 201
parasites ... 243
quarantine ... 246
work ... 231
Glassware, dairy ... 354
Glycerin ... 329
Gossyparia spuria ... 206
Grain moth, Angoumois ... 269
Grapevine tomato gall ... 158
Grasselli Chemical Co. fertilizer ... 11
Green aphids ... 150
apple ... 134
Greenhouse leaf-tyer ... 298
Ground Bone ... 52
analyses of ... 54
Heliothis obsoleta ... 203
Hemerocampa leucostigma ... 200, 205
Hemerophila pariana ... 200
Hen flea, European ... 209, 279
Home Mixtures ... 78
analyses of ... 79
Honey ... 320
analyses of ... 321
Honeysuckle sawflies ... 158
Humphreys-Godwin Co. fertilizers ... 3, 11, 27, 30, 31, 32, 33
Hyalopterus arundinis ... 199, 297
Hydriodic acid, dilute ... 331
Hylemyia brassicae ... 203
cilicrura ... 203
Hylobius pales ... 206
Hyphantria cunea ... 200, 204
Ice Cream ... 317
Illinoia pisi ... 204
Impatiens Balsamina ... 208
Imported currant borer ... 134
worm ... 129
Insecticide substitutes for nicotine sulphate ... 277
Insect pests of nursery stock in Connecticut ... 119
Insects, general feeders ... 119
injuring deciduous shade and forest trees ... 141
fruit stock ... 124
perennial plants ... 168
shrubs and vines ... 154
pests of Evergreen trees and shrubs ... 160
Inspection, Apiary ... 223
imported nursery stock ... 221
nursery ... 210
raspberry plantations ... 219
International Agricultural Corp. fertilizers
3, 11, 12, 18, 19, 27, 33, 38, 41, 43, 52, 54, 68
Io caterpillar ... 155
Iodine, comp. solution of ... 330
analyses of ... 330

PAGE
Iris borer.... 208
 root borer.... 171
Iron and ammonium acetate.... 330
 analyses of.... 331
Janus abbreviatus.... 212
Japanese beetle.... 127, 201
 control work.... 281
 quarantine.... 286
Joynt, John Co., Inc., fertilizers.... 12, 41, 49
Juniper scale.... 167
 webworm.... 161, 207
Kalmia latifolia.... 220
Kellogg, Spencer & Sons, Inc. fertilizers.... 12, 27, 35
Kermes, sp.... 206
Kuttroff, Pickhardt & Co., Inc. fertilizers.... 12, 21
Larch case bearer.... 141
 sawfly.... 146
 woolly aphid.... 207
Laspeyresia molesta.... 197, 200, 263
Laurel inspection.... 220
Leaf hoppers on apple.... 138
 roller, red-banded.... 200
Lecanium corni.... 201, 206, 296
 European.... 206
 fletcheri.... 296
 nigrofasciatum.... 206
Leopard moth.... 119, 205
Leptinotarsa decemlineata.... 202
Leptobyrsa rhododendri.... 208
Lilac borer.... 158
Limax agrestis.... 203
Lime.... 78
 analyses of.... 84, 85
 chlorinated.... 331
 water.... 326
 analyses of.... 326
Lina scripta.... 212
Linden borer.... 148
 moth, snow-white.... 200
Linseed Meal.... 27, 35
Locust borer.... 148
 leaf miner.... 142, 206
 17-year.... 297
Lovitt, L. B. & Co. fertilizers.... 3, 12, 27, 33
Lowell Fertilizer Co.... 12, 68, 70
Lycophotia margaritosa saucia.... 201
Macrocentrus ancylivora.... 268
Macronoctua onusta.... 208
Macrosiphum solanifolii.... 204
Mamestra picta.... 203
Mapes Formula & Peruvian Guano Co., The, fertilizers
 12, 18, 19, 41, 43, 52, 54, 70
Maple leaf bladder gall.... 207
 scale, cottony.... 298
 scale, cottony.... 299
 syrup.... 322
Markham, A. G. & Co. fertilizers.... 13, 70
Meat products.... 317

PAGE
Melittia satyriniformis 203
Memphis Cottonseed Products Co. fertilizers 3, 13, 27, 34
Mercury, mass of 332
analyses of 332
Mercuric salicylate 332
Milk and milk products 318
evaporated 318
human 318
Miscellaneous Fertilizers 86
materials examined for poisons 351
Mites 150
Mixed Fertilizers 57
analyses of 62
Monarthropalpus buxi 208
Monophadnoides rubi 201, 297
Mosquito control work 291
Myzus cerasi 199
persicae 204
ribis 199
Narcissus inspections 220
Natural Guano Co. fertilizers 13, 78, 82
Neal, R. N. & Co. fertilizers 3, 13, 27, 34
Neodiprion pinetum 205
New England Fertilizer Co 13, 70
Standard Nine 61
New York Weevil 131
Nicotine sulphate substitutes 277
Nitrate of Soda 18
analyses of 19
Nursery dealers 220
firms in Connecticut 215
inspection 210
pests 211
stock, imported, inspection 221
Oak gall scales 151, 206
scale, pit-making 151, 206
Old Deerfield Fertilizer Co 13, 72
Olds & Whipple, Inc. fertilizers
13, 18, 19, 22, 26, 35, 36, 38, 40, 41, 42, 43, 48, 49, 52, 54, 72
Olive Oil 316
Onion maggot 204
thrips 204
Oriental Peach Moth 132
Ornamentals, Insects attacking 207
Otiorhynchid weevils 163
Oyster-shell scale 123
Oysters 319
Pacific Manure & Fertilizer Co 13, 78, 82
Pales weevil 163, 206
Papaipema nebris 208
nitela 203
Papilio podalirius 223
Paratetranychus pilosus 199
ununguis 207
Parharmonia pini 205
Parmenter & Polsey Fertilizer Co 13, 72
Pea aphid 204
Peach borer 132
moth, Oriental 132, 197, 200, 263

PAGE

Pear leaf blister mite 140, 199
  midge 201
  psylla 199
  slug or sawfly 129, 201
Pepsin, powdered 332
  analyses of 333
Phorbia ceparum 204
Phyllaphis fagi 207
Phyllocoptes quadripes 207
Phlyctaenia ferrugalis 298
Physokermes piceae 206
Pickles 319
Piedmont Mt. Airy Guano Co. fertilizers 14, 18, 19, 38, 52, 55
Pine bark aphid 166, 207
  leaf scale 166, 207
  sawflies 161, 205
  shoot moth, European 205
  weevil, white 205
Pipe-vine caterpillar 156
Pissodes strobi 205
Pitch-mass borer 205
Pit-making oak scale 151
Plagiodera versicolora 206, 212
Platt, Frank S. Co., Inc. fertilizers 14, 72
Plum aphid, mealy 199, 278, 297
  curculio 197, 200
Poisons, materials examined for 351
Pontia rapae 203
Popillia japonica 201, 281
Poplar borer 149
  curculio 206, 297
  tent maker 146
Porthetria dispar 201
Potash, Carbonate of 40
  analyses of 42
  —Magnesia, sulphate of 41
  analyses of 44
  Muriate of 40
  analyses of 42
  Sulphate of 41
  analyses of 43
Potato aphid 204
  beetle, Colorado 202
Premier Poultry Manure Co. 14, 78, 82
Preservation of Tobacco Tent Poles T2
Projects active during year 105
Prunus domestica 297
Psila rosae 203, 278
Psylla pyricola 199
Pteronidea ribesi 196
Publications, List of 108
Pulverized Manure Co., The, fertilizers 14, 78, 82
Pulvinaria acericola 299
  vitis 299
Pyrausta nubilalis 246
Pyrethrum extracts 277
Quercus robur 206
Rackliffe Bros. Co., Inc. fertilizers 14, 18, 20, 72

PAGE

Raspberry inspection........ 219
sawfly........ 201, 297
Red-humped caterpillar........ 126, 200
Red mite, European........ 199
spider........ 208
Registrations, List of........ 7
Report of
Board of Control........
Director........ 89
in account with Insect Pest Appropriation....
Mosquito Appropriation.....
Tobacco Appropriation......
Treasurer........ 8
Tobacco Station, 1927........ T 17
Chemical analyses of Tobacco from Nitrogen Plots T 35
Effect of some Nitrogenous Fertilizers on Soil Reaction........ T 51
Fractional Application series........ T 57
Influence of Some Fertilizer Ingredients on the Burn of Tobacco........ T 18
Manure as a Supplement to Commercial Fertilizer. T 62
Organic Matter in Tobacco Soils........ T 66
Progress Report on the Cover Crop Experiment... T 72
Single Sources of Nitrogen........ T 60
Tobacco Mosaic........ T 75
Rhagoletis pomonella........ 201
Rhododendron borer........ 165
lace bug........ 167, 208
Rhus canadensis........ 213
Rhyacionia buliana........ 205
Rocky Mountain Fertilizer Co........ 14, 78, 82
Rogers & Hubbard Co., The, fertilizers........14, 38, 52, 55, 72, 74
Rose chafer........ 128
leafhopper........ 199
sawflies........ 157
scale........ 159
stem girdler........ 158
Royster, F. S. Guano Co. fertilizers..3, 15, 18, 20, 38, 41, 43, 48, 49, 74, 78, 82
Sacbrood........226, 227, 230
Saddle-back caterpillar........ 155
Salad dressing........ 319
San José scale........ 137, 199
Schizura concinna........ 200
Scurfy scale........ 137
Seed tests, vegetable........ 177
Sheep Manure, etc........ 78
analyses of........ 82, 83
Shoemaker, M. L. & Co., Inc. fertilizers........15, 52, 55, 74
Shot-hole borer........ 133
Silver fish........ 209
Sitona sp........ 223
Sitotroga cerealella........ 269
Sminthurus hortensis........ 203
Spade, Mosquito ditching........ 298
Special foods........ 312
analyses of........ 313
Sphecodina abbotii........ 207
Sphinx caterpillars or horn worms........ 156

PAGE

Spinach aphid 204
Spotted willow leaf beetle 145
Spraying and dusting apples 256
Springfield Rendering Co. fertilizers 15, 74
Spruce bud scale 206
worm 162
gall aphid 165, 207
blue 207
mite 167, 207
Squash borer 203
Stalk borer 170, 203, 208
Strawberry leaf roller 208, 269
Sulphuric acid, aromatic 333
analyses of 333
Superphosphate (Acid Phosphate) 37
analyses of 38
Tankage 52
analyses of 53
Tarnished plant bug 139
Tarsonemus pallidus 208
Tea 322
Tent caterpillar, Eastern 200
Terrapin scale 152, 206
Tetralopha robustella 206
Tetranychus bimaculatus 208
Thermobia domestica 209
Thomas, I. P. & Son Co. fertilizers 15, 18, 20, 38, 41, 43, 52, 53, 55, 74, 76
Thyroid 333
Tibicina septendecim 297
Tmetocera ocellana 200
Tobacco, denicotinized and ordinary, analyses of 341
prolonging life of, Shade Tent Poles . . . . T 1
report of Tobacco Station, 1927 . . . . T 17
Tomato catsup (ketchup) 322, 323
analyses of 324
Toumeyella liriodendri 206
Tree insects, shade and forest 204
Trichogramma minuta 268, 269
Trioza tripunctata 298
Triton Oil & Fertilizer Co 15, 18, 20, 38, 76
Tulip tree scale 152, 206
Tussock moths 121
white-marked 200, 205
United States Guano Co. fertilizers 16, 18, 20, 38, 76
Urea, analyses of 21
Vanessa sp 223
Vegetable insects 201
seed bought by market gardeners in Conn. in 1927 179
Vinegar 323
Vine weevil, black 208
Virginia-Carolina Chemical Corp. fertilizers 16, 76
Vitamins A and D, color tests for 334, 336
A, feeding tests for 336
Water analyses 354
Webworm, fall 200, 204
White grubs 164
peach scale 159
pine weevil 164

PAGE
Wilcox Fertilizer Co. 16, 38, 47, 49, 53, 55, 76
Willow aphids 151
borer 149
curculio 206, 297
flea beetle 145
leaf beetle, imported 145, 206
spotted 145
Wood Ashes 12, 41
analyses of 45
Woodruff, S. D. & Sons, fertilizers 16, 76, 78, 82
Woolly, apple aphid 135
Worcester Rendering Co. fertilizers 16, 76
Xylina antennata 200
Yellow-necked caterpillar 127, 200
Young, William P. & Son, fertilizers 16, 76
Zebra caterpillar 203
Zeuzera pyrina 205

Tobacco Bulletins

TOBACCO STATION BULLETIN 9 NOVEMBER, 1927

Connecticut Agricultural Experiment Station

New Haven, Connecticut

PROLONGING THE LIFE OF TOBACCO SHADE TENT POLES

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

SUMMARY.

1. Within a comparatively few years the supply of chestnut suitable for posts and poles will be exhausted.

2. Most of our native species suitable for this purpose are naturally non-durable in contact with the soil.

3. The durability of poles can be greatly increased by the use of preservatives to keep out organisms causing decay.

4. Coal tar creosote, or some product derived from it, is the best material to use.

5. Treating can be done satisfactorily in simple, inexpensive outfits constructed and operated on the farm.

6. Immersing the butt of a pole in a hot bath (220° F.) and then in a cool bath (100° F.) will result in the absorption of about one-half gallon of oil and in a penetration of one-half inch to one inch.

7. The above process is called the Open Tank Method and poles treated in this way may be expected to have a useful life of ten years or more.

8. Preservative treatment is not new. Railroad, Pole Line and Mining Companies have saved millions of dollars by using it.

PROLONGING THE LIFE OF TOBACCO SHADE TENT POLES.

H. W. Hicock[1] and P. J. Anderson[2]

Three hundred and fifty thousand chestnut poles are used to support the tobacco shade tents of the Connecticut Valley. Every year some of these must be replaced because they have rotted off at the ground. The increasing acreage of shade tobacco is swelling the demand for new poles, and to meet this demand there is a steadily diminishing supply of chestnut. The present supply of poles is coming from blight killed timber and within a comparatively few years this supply will be exhausted. Poles from dead timber are often partially rotten when cut, and consequently have a shorter life than formerly when chestnut was cut green, peeled and properly seasoned. This necessitates more frequent replacement. Poles are being brought from greater distances, which increases the cost for transportation. All these factors mean an increased cost to the shade tobacco grower.

Up to the present, other species of trees have not been used for tent poles, either because they were too expensive or because they were not durable in contact with the soil. The shade tobacco grower is now confronted with two problems:

1. That of prolonging the life of such chestnut poles as he may be able to secure.
2. That of providing satisfactory substitutes for chestnut when the supply of this species is exhausted.

The most feasible way of accomplishing both these ends is to use some sort of preservative treatment. The present bulletin is distributed with the object of furnishing what we believe to be the best information available as to the use of wood preservatives for this purpose.

While this paper deals specifically with the application of preservatives to tobacco shade tent poles, the methods described are applicable wherever it is desirable to prolong the life of wood by preventing decay.

Preservative Material.

The main requirements of a good preservative are that it render wood unfit for the development and growth of the organisms (fungi) causing decay, that it be reasonably permanent, and that it be inexpensive. Without discussing the merits of the va-

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rious preservatives that might be used it may be stated that *coal tar creosote,* or some product derived from it, is the best material to use. Coal tar creosote itself is difficult to obtain in small quantities, but there are on the market many derivatives of it which may be purchased in lots of a gallon or more under various trade names. Such products will cost more than creosote, but the fact that they are the only materials easily obtainable in small quantity will render their use compulsory on small jobs. In purchasing preservative the best plan is to secure materials made by a reliable concern which will furnish specifications regarding the characteristics of its product.

In choosing between several preservatives, select the cheapest one that will answer the requirements of the job. Below is the American Wood Preservers' Association standard for Grade I creosote oil which may be used for comparison in purchasing trade products. Some deviation from these requirements is, of course, allowable but the least that any buyer should do is to assure himself that the preservative is a distillate of coal-gas tar or coke-oven tar and that it has a boiling point of over 200 degrees centigrade.

AMERICAN WOOD PRESERVERS' ASSOCIATION STANDARD SPECIFICATION.

Grade I.

1. The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:
2. It shall not contain more than 3 per cent of water.
3. It shall not contain more than 0.5 per cent of matter insoluble in benzol.
4. The specific gravity of the oil at 38° C. compared with water at 15.5° C. shall not be less than 1.03.
5. The distillate, based on water-free oil, shall be within the following limits: Up to 210° C., not more than 5 per cent; up to 235° C., not more than 25 per cent.
6. The residue above 355° C., if it exceeds 5 per cent, shall have a float test of not more than 50 seconds at 70° C.
7. The oil shall yield not more than 2 per cent coke residue.
8. The foregoing tests shall be made in accordance with the standard methods of the American Wood Preservers' Association.

PREPARATION OF POLES FOR TREATMENT.

Only sound wood should be selected for treating because, if decay has already started, treatment may not kill the fungi responsible for it and the organisms will continue to work inside the treated area. If a pole shows signs of decay it should be rejected or the decayed portion should be shaved off. *This is particularly important with dead chestnut, which is often punky on the outside.*

Poles should be peeled for their entire length, taking especial care to remove *all* the fibrous inner bark from the area to be treated. After peeling they should be piled in open cribs to permit a thorough circulation of air around each pole and allowed to season. The length of time needed for seasoning will vary with the time of year and the species. A test to determine the degree of seasoning may be made by weighing periodically. If an average sized pole loses a pound or less a week in good drying weather it is dry enough to treat. Seasoned timber which has been exposed to rain should not be treated until it has dried out again. Species like oak, which check badly, should be cut and peeled in the fall and winter since seasoning proceeds less rapidly at this time of the year. Some species "case harden" by forming an impervious shell on the outside when seasoning. This shell should be broken by rasping or scraping before treatment.

It should be remembered that, in general, sapwood is more easily treated than heartwood, although there are exceptions to this rule. Wood which is to be treated by brushing, spraying or dipping may be round, sawn or split since the treatment is superficial and there is little penetration of the wood cells by preservative. But if treatment is to be by the open tank method, it is better to use round material because the band of easily penetrated sapwood on a round stick insures an even penetration of preservative to a considerable depth. The smallest round pole which is strong enough to meet the requirements of the job is preferable to a larger one because it has a larger percentage of sapwood than the latter. Should chestnut be treated by the open tank method, care should be taken to retain as much sound sapwood as possible because the heartwood is very difficult to penetrate with preservative.

Application of Preservatives.

There are a number of ways of applying preservatives, each of which has its merits. The user must decide for himself as to which best fits his conditions.

Brush Treatment. This is the easiest, cheapest and least effective means of application. It consists in flowing on the preservative with a stiff brush or swab, or spraying it on with a pressure gun. The preservative may be applied cold but better penetration will be obtained if it is heated to about 200° F. Two or more coats should be applied, allowing a twenty-four hour interval between coats. Care should be taken to fill all checks and depressions. The advantages of the method are that it requires almost no equipment and the preservative can be applied where it is most needed. The area treated should extend one foot above and two feet below the ground line. The chief drawback

to the method is that there is little penetration and the durability is consequently not increased as much as with some of the other processes. A two coat application requires about ten gallons of preservatives per thousand square feet of surface and may be expected to prolong the life of timber from three to five years. The main use of this method is for increasing the life of wood that is in itself naturally durable. It is particularly recommended for use on dead chestnut poles.

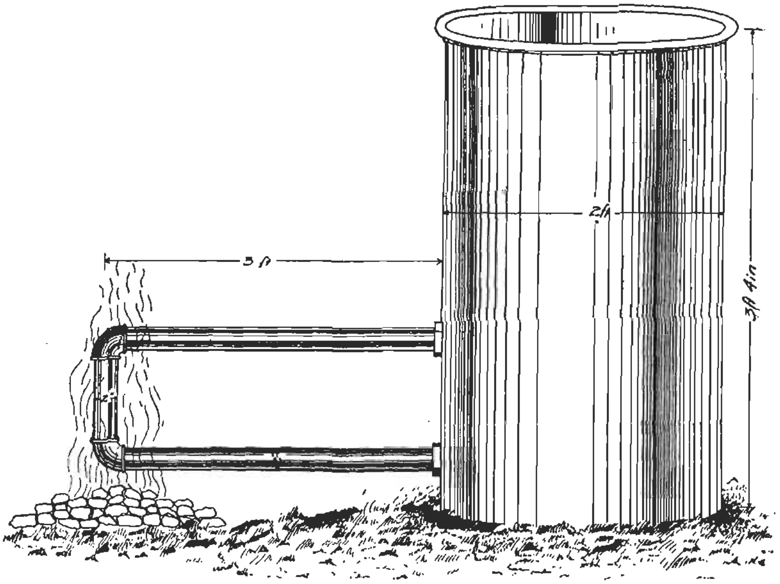

FIG. 1. *An easily constructed outfit* which can be readily transported from place to place. The tank is of 24 guage galvanized iron with a capacity of 15-20 poles a day which could be doubled by providing a second tank for the cool creosote.

Dipping. By this method the butts of the poles are dipped for five to fifteen minutes or more in preservative which has been heated to 200° F. The increase in durability which may be expected will be about the same as for brushing or spraying. It is considered slightly more effective than the latter because the preservative enters into places not reached by brush or spray. However, it uses more preservative per unit of area treated and its application requires a tank and some method of heating the oil. This method is not especially recommended. If the expense for tanks, etc., is to be incurred it would be better to employ the Open Tank Method described below.

Open Tank Method. This is the most practicable method for treating shade tent poles of non-durable woods. The apparatus

required may be very simple or quite elaborate, according to the number of poles to be treated. In its simplest form it consists of a steel barrel (old gasoline drum with one head removed) and a thermometer. The barrel is set up over a hole in the ground, or on a stone or brick foundation, and a fire started under it to

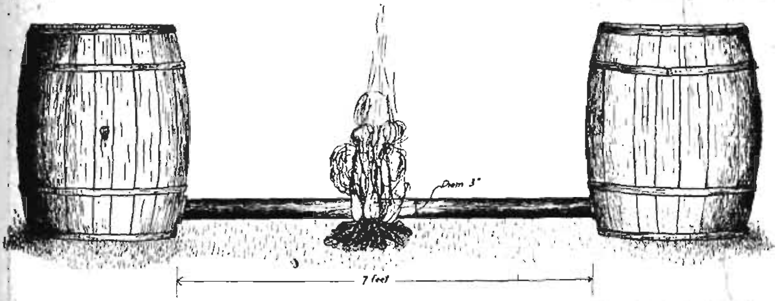

FIG. 2. This outfit consists of 2 tight barrels, 7½ feet of 3 inch pipe, four 3 inch lock nuts and four 3 inch rubber gaskets. Capacity 15-20 poles daily. This may be doubled by providing 2 more barrels for the cool creosote.

heat the oil. If desired, a U-shaped return bend may be inserted in the barrel. If this is done, heating of the oil is accomplished by applying a blow torch flame to the bend or starting a fire under it. (See Figure 1). Another scheme is to connect two barrels by means of a seven-foot length of three-inch pipe. Heating is accomplished by starting a fire under the pipe. (See Figure 2). If either of these two plans is used the barrel may be of wood. The depth of the barrel needed is governed by the length of the butt to be treated. The treated part of a pole should extend for at least six inches, and preferably a foot, above ground line. The barrel should then be a foot deeper than the treated portion of the pole to allow for expansion of the oil. To prevent poles from moving about or floating in the oil, it is a good plan to construct a false bottom out of two-inch plank with heavy screws projecting upward through it for about three-fourths of an inch and to fasten this in the bottom of the barrel. (See Figure 3).

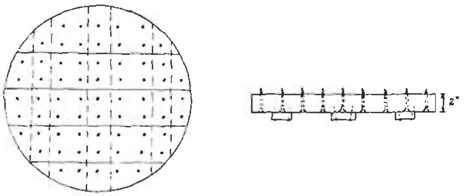

FIG. 3. This device is to be fastened in the bottom of the barrel or tank to keep the poles from floating and can be made of scrap materials. The screws should project for ¾ inch.

The operation of one of the forms of equipment described above consists in immersing the butts of the poles in preservative and maintaining the latter at a temperature of 220° F. for three hours. The fire is then drawn and the poles allowed to stand in the oil for twelve hours or more. A single tank outfit designed to be operated in this manner is shown in Figure 4.

FIG. 4. A home-made single tank treating plant in operation. A tank like the one shown is better than a barrel because of its greater depth. Note the drain barrels at the left.

An elaboration of the above method, which will greatly speed up the process, is to provide another tank or barrel containing oil at a temperature of about 100° F. The poles are immersed in the hot bath for three hours as before and are then immediately transferred to the cool bath and allowed to remain in it for one to two hours. (See Figure 5). This accomplishes the same result as allowing them to stand in the cooling oil for a much longer period.

The apparatus thus far described is suitable for butt treatments only and in northern climates this will usually be sufficient. However, should it be desirable to treat the tops as well, this can be done by immersing the entire pole in the cool bath after the butts have been treated to the hot bath as described above. The complete two bath treatment for the entire pole is sel-

dom warranted. Treating the tops of the poles in the cool bath requires a tank long enough so that they may be immersed. (See Figure 6). It is a good plan to provide a number of extra barrels in which the poles may be placed to drain when they are removed from the cool oil.

Further elaborations may be made in the size and shape of the bath tanks, methods of heating, tackle for handling the poles, etc.; but, in any case, the principle involved is the same, i.e., the hot bath drives the air and water out of the wood cells, creating a partial vacuum. When the oil is allowed to cool, or when the wood is immersed in the cold bath, the preservative is forced into the vacuum.

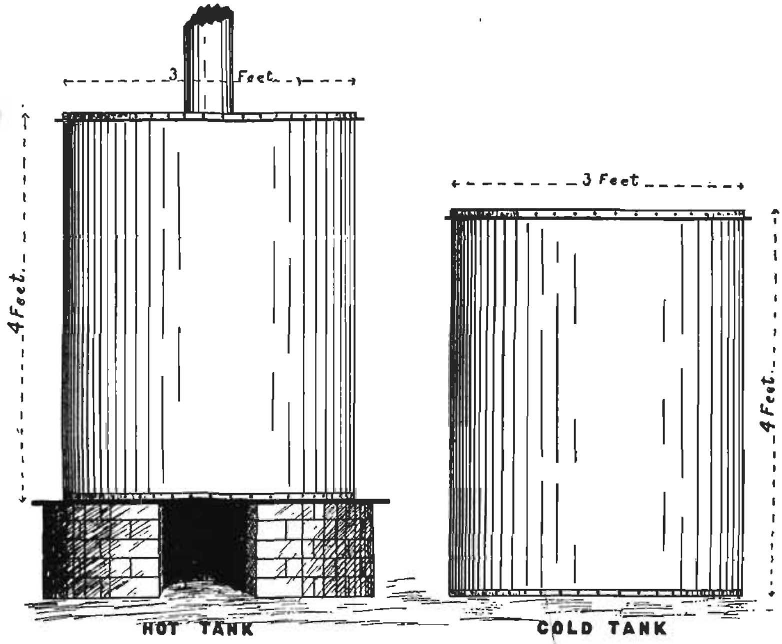

FIG. 5. A two tank outfit. Capacity 50-60 poles daily. The tanks should be of heavy galvanized iron reinforced at the top and bottom with angle iron.

The average butt treated pole will absorb about one-half gallon of creosote in the hot and cold baths. The depth to which penetration takes place is from one-half inch to more than one inch, depending on the species. Immersing the entire pole in the cold bath adds somewhat to the amount of preservative used.

While more costly both as to materials and equipment than the more superficial methods of brushing, spraying and dipping,

this expense is fully justified with species which are non-durable. Tests made at a number of Experiment Stations show that, in northern climates, species which normally have a life of from one to five years when used in the ground will be serviceable for ten years or more when treated by this method.

Full Pressure Treatment. This method, which consists in forcing preservative into the wood under high pressure, is only mentioned because the high cost of equipment will prohibit its use except where a large amount of material can be treated. By the use of pressure it is possible to force from five to fifteen pounds of preservative into each cubic foot of wood. With such heavy

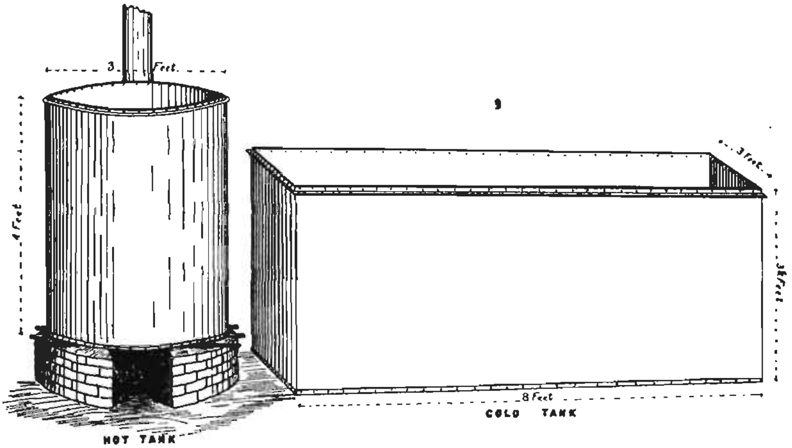

FIG. 6. This is a modification of the two tank outfit shown in Figure 5 to allow for immersion of the entire stick in the cool oil. For tent poles the rectangular tank should be at least 12½ feet long.

impregnation, species of wood which are naturally non-durable may be expected to have a useful life of 20 years or more in contact with the soil.

Natural Durability.

There are only four native woods which have good natural durability when used in contact with the soil. They are chestnut, locust, white oak and red cedar heartwood. From a commercial standpoint chestnut may be considered an extinct species. White oak and red cedar heartwood make good poles so far as durability is concerned, but both grow rather slowly and both have values for special purposes which will generally preclude their use for poles. Moreover, white oak is rather heavy for this purpose. Locust is very durable, but it cannot be grown commercially on account of a serious insect pest.

In the future the bulk of the post and pole supply must come from other native woods, preferably those which can be obtained near at hand. These may be generally classed as non-durable. A few of them will last for five to ten years untreated, but most of them rot off in less than five years in contact with the soil. It is for this group of non-durable woods that treatment is especially important.

Non-Durable Species Which May Be Used.

The requirements for a good pole or post wood are that it be reasonably light, straight, strong, easily obtainable and susceptible to treatment.

HEAVY WOODS.

Oaks. The common black oaks (those having pointed leaves—red, pin, scarlet and black) may not be considered suitable for posts and poles because of their weight, but they are easy to obtain and can be creosoted with good penetration.

Hickories, Black and Yellow Birch and Sugar Maple. These species are not only heavy but are not easily treated and should not, in most cases, be used for posts and poles.

Beech. Beech, while moderately heavy, takes preservative readily and is worth considering where available.

White Ash. White ash is similar to beech in weight but is a little harder to treat. However, its straight growth renders it suitable for poles and, where obtainable, could be used to advantage.

LIGHT WOODS.

The Pines and Hemlock. The pines are reasonably light when dry and are easily treated. Pitch or yellow pine is readily obtainable over most of the tobacco region and at present has little or no value. If treated and used for poles, an economic waste would be diverted into useful channels. White pine is also plentiful, and red and Scotch pine could be grown to advantage to supply post material (See the Rainbow Experimental Plantations). Hemlock, while suitable in weight and form, is difficult to treat and should not be used untreated since it is not durable in the soil.

Elm and Sycamore or Buttonball. Elm is a light wood and one most easily treated. In fact, it absorbs preservative almost too readily. Sycamore is also easily treated, although less so than elm.

Red or Soft Maple. This tree is particularly recommended for post and pole material because of its good form and the fact that it is so readily obtainable. It takes treatment well and considered from all angles, it is one of the most likely species that can be suggested.

Gray Birch, Poplar, Willow and Basswood. These are light species. The poplars, willow and basswood take treatment readily and when available should make good poles. Gray birch is one of our least durable woods. There is little information available at present as to the ease with which it may be treated and it can not be recommended at this time. However, its abundance warrants experiments to determine its practicability as treated post material.

Care of Poles After Treatment.

Great care should be taken to prevent the treated portions of poles from being broken. Should the preserved shell be opened up in any way it should be brushed over with one or two coats of hot creosote before the pole is set.

All framing, sharpening, etc., should be done before treating. Should it be necessary to cut into a pole after treatment, the fresh cuts should be brushed over.

If only the butts are treated the poles should be piled in open cribs, otherwise decay may start in the untreated tops. If the entire pole is treated, close piling should be used as there is less chance for the preservative to be lost by volatilization.

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TOBACCO STATION BULLETIN 10 MARCH, 1928

Connecticut Agricultural Experiment Station

New Haven, Connecticut

A THOUSAND ACRES OF SHADE TENT ON WINDSOR PLAINS.

REPORT

OF

TOBACCO STATION

AT WINDSOR

1927

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

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TABLE OF CONTENTS.

	PAGE
Influence of Some Fertilizer Ingredients on the Burn of Tobacco	18
Factors which influence the burn	18
Important points in judging the burn	20
Methods of testing the burn	21
Some nitrogenous fertilizer materials	23
Potash salts	30
Quantity of phosphorus	32
Lime	33
Summary	34
Chemical Analyses of Tobacco from the Nitrogen Plots	35
Methods of analyses	36
Summaries of analytical data	38
Discussion of analytical data	41
Summary	49
The Effect of Some Nitrogenous Fertilizers on Soil Reaction	51
Synthetic Urea as a Source of Nitrogen	55
Fractional Application Series	57
Single Sources of Nitrogen	60
Manure as a Supplement to Commercial Fertilizer	62
Organic Matter in Tobacco Soils	66
Progress Report on the Cover Crop Experiments	72
Tobacco Mosaic	75
Effect on host	76
Cause	77
Known facts of mosaic	78
Preventive measures	81

Report of the Tobacco Substation 1927

P. J. Anderson, N. T. Nelson, and T. R. Swanback

Following the custom of previous years this annual report is presented to the tobacco growers of the state to inform them of the progress of experiments which are under way at the Tobacco Substation. Each year old projects are enlarged, new projects are undertaken and more data accumulate. Since a complete report on all experiments would be too lengthy, it has seemed best to confine this one to certain projects which have not been previously discussed or are of particular interest at this time, reserving the others for separate bulletins. Bulletins which are now in preparation and will soon be ready for distribution are:

Topping Havana Seed Tobacco.
Soil Reaction as a Factor in Growing Tobacco.
Priming and Curing Shade Tobacco.

The year has been marked by a steady increase in the amount of time the members of our staff have given to public and personal service work with the tobacco growers. Each year farmers and packers are making more use of the station. Requests for personal conferences regarding fertilizers, methods of curing and the like have more than doubled. A great deal more time has been spent in testing acidity of soils, testing germination of seed and answering calls for personal visits to farms. Correspondence with growers, packers, manufacturers, fertilizer firms and others interested in tobacco has increased correspondingly.

In July the annual field day in cooperation with the New England Tobacco Growers' Association was attended by several hundred growers. In September we staged a tobacco exhibit at the Connecticut State Fair in cooperation with the Connecticut Leaf Dealers' Association. This exhibit was visited by thousands of people during the week and served a useful purpose in acquainting the people of the state with the importance of the tobacco industry and the work of the Tobacco Station.

The increasing volume and importance of this type of work will soon require the entire time of one man. It would be desirable to add such a man to our staff and thus conserve the attention of the present staff for research alone.

INFLUENCE OF SOME FERTILIZER INGREDIENTS ON THE BURN OF TOBACCO

Connecticut tobacco is raised for smoking only. Obviously if it does not burn well, it is of little value. To be sure, there is always a market for low grades which are used for scrap chewing but they command a price so low that the crop is raised at a heavy loss if sold for this purpose. Chewing tobacco is only a by-product of the cigar leaf industry, a utilization of what would otherwise be loss. The first requisite of our tobacco then is that it shall have a good burn. A fine growth, heavy yield and excellent appearance of the cured leaf are of no avail if the tobacco does not burn well.

TOBACCO EXHIBIT AT THE CONNECTICUT STATE FAIR, SEPTEMBER, 1927.

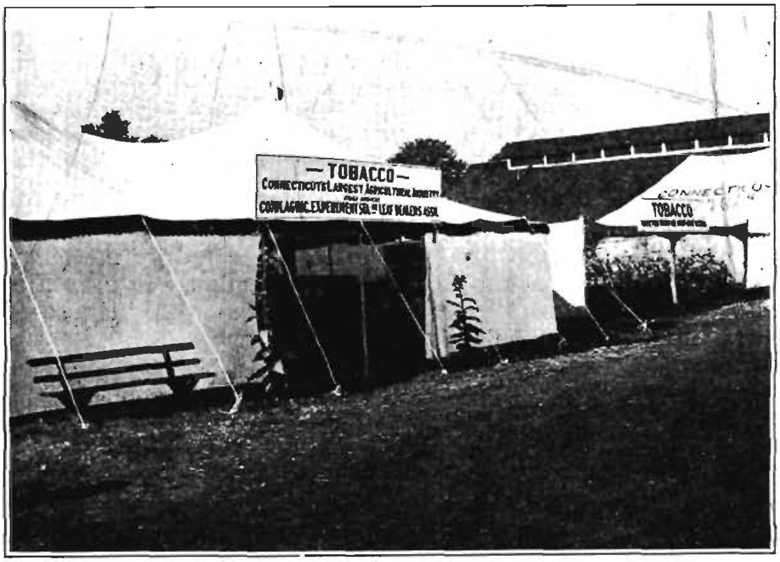
In connection with the fertilizer experiments burn tests have been made to determine what effects the fertilizers applied to the soil have on the burn of the tobacco. These tests were begun with the crop of 1925 and repeated annually, but no previous report on them has been published. It is the purpose of this first report to present and discuss the burn data to date.

FACTORS WHICH INFLUENCE THE BURN

The burn is influenced by a number of other factors besides the fertilizer applied. The burn possessed by a given lot of tobacco

is a resultant of the interaction of a number of these influences and it is rarely possible to predict the effect of each factor except by trial. Some of these factors are:

1. **The locality.** Although cigar tobacco has been grown experimentally all over the United States and in most of the countries of the world, the industry has survived in a few restricted localities only which now supply the world's markets. Attempts to establish new centers of production, with a very few notable exceptions, have been failures; not because tobacco would not grow in other places but because some one or more of the characteristics of burn or quality did not satisfy the smoker. Even within the tobacco sections there are certain localities which produce tobacco of characteristics distinctive from the tobacco produced in other localities of the same section. To determine the causes of these differences is one of our problems.



TOBACCO TENTS AT THE CONNECTICUT STATE FAIR.

2. **The climate.** Temperature, humidity, distribution of rainfall, occurrence of frosts and prevalence of fogs at certain periods all have their influence on burn and quality.

3. **The soil.** Even within small tobacco sections, growers have found by experience that certain types of soil produce tobacco with excellent burn, while others are not suitable. Most tobacco farmers find that certain fields on their farms grow tobacco of better quality than others, consequently they raise it continuously

on one certain field which comes to be known as the "tobacco lot" and may remain the same through several generations.

4. **The season.** It is a well known fact among dealers and manufacturers that crops of certain years are poor "burners" and they purchase as little as possible of the tobacco of that season, while they are eager to "stock-up" with all they can get of the crop of other seasons which are known to have yielded leaf of fine burn. Seasons of insufficient rainfall are likely to give poor burn.

5. **The method of handling.** Differences in methods of cultivation, in time and stage of topping, suckering, and harvesting may influence burn.

6. **The cure.** The rapidity of cure and the temperature and humidity at which this process occurs have been found to influence burn.

7. **Fermentation.** The principal purpose of sweating and resweating tobacco is to improve the burn.

IMPORTANT POINTS IN JUDGING THE BURN

In judging the burn, the following points are taken into consideration:

1. **Fire holding capacity.** This is measured by the length of time during which a leaf or a cigar continues to glow after being ignited. The longer it glows, the better the tobacco—at least, up to a certain optimum.

2. **Color of ash.** The most desirable ash is light gray to white. Muddy gray, dark gray and black ashes are objectionable. Ash color can be judged only on the cigar. The ash of a single leaf held between the hands may be dark gray or black but when the leaf is wrapped on the cigar it frequently gives a gray or white ash. Color of ash is governed by completeness of combustion and, to some extent, by abundance of some calcining agent like lime. When the combustion is not complete, considerable carbon remains and this causes dark color.

3. **Closeness of burn.** This also can be judged only on the cigar. The black band which precedes the red line of glow should be very narrow—not over 1/25th of an inch—and sharp. When it is broad and of indefinite outline it is called "coaling." This is objectionable. Sometimes this is the fault of an improperly matched filler, binder and wrapper. A filler which burns too rapidly is likely to cause "coaling." Coaling is commonly accompanied also by bad aroma and taste and a darker ash color.

4. **Evenness of burn.** The line of ignition should be regular and pass in a straight line around the cigar. Like the preceding, a defect in this respect is quite often due to improper manufacture of the cigar.

5. **Flavor.** Although there is some looseness in the use of this term, we apply it to the gustatory sensation received when the inhaled smoke comes in contact with the tongue and other parts of the mouth. Some apply the term to the taste of the tobacco itself when certain constituents of the head of the cigar go into solution in the mouth. Or it may refer to the combination of the two.

6. **Aroma.** The odor of the smoke is very important in judging the value of tobacco. Certain sections of the world owe their prominence in the tobacco industry entirely to the aroma of the tobacco grown there. Tobacco which does not burn with a pleasing aroma is worthless for smoking purposes.

The preferences of smokers differ so much that there has not been any satisfactory method devised for measuring or evaluating the aroma and flavor. On account of this difficulty and the fact that no marked differences due to fertilizer treatment have been detected in our tests, we have omitted all reference to these two factors in the following discussion.

7. **Coherence of ash.** Coherence of ash refers to its capacity for remaining in compact form for a considerable time after combustion. Coherence is good if the ash of a cigar remains intact for one inch or more after burning. Some split and fall off in large chunks or curl. Some are "flakey" and small particles keep falling away during smoking. Either of these characteristics is undesirable. An exceptionally good ash often will keep the exact form of the cigar until it is two or three inches long without flaking, splitting, crumbling or falling off.

METHODS OF TESTING THE BURN

There are two methods of testing the burn of tobacco. The first method, known as the "strip test", is made by lighting a single leaf while held in the hands. In the second, the "cigar test," the leaves are rolled on a cigar before lighting.

The strip test is most useful in comparing the fire-holding capacity of lots of tobacco. It may also prove the aroma. It cannot be used for determining flavor, ash color, closeness or evenness of burn, or coherence of ash. A good fire-holding capacity, however, as indicated on the strip test, is usually associated with a desirable condition of the other factors mentioned.

The tobacco buyer makes considerable use of the strip test. He stretches the leaf taut between his two hands and then ignites it either with the glowing end of a cigar or with a match. Ignition of the leaf by the burning end of the cigar is the ideal method of making the strip burn test. A match, candle, or Bunsen burner starts a flame which rapidly chars the leaf. A steady spreading line of ignition without flame is the desired condition. In making

a large number of tests involved in the comparison of tobacco from different experimental plots, ignition by the lighted cigar is obviously not practicable. We have, therefore, adopted a method which most closely simulates it, *viz.*, ignition from an incandescent electric filament wound in a coil such as one finds in electric cigar lighters. We have used a commercial cigar lighter sold under the name of "Hold-heet", which is supported on a stand like a desk telephone and with a coil so exposed as to be easily touched by the taut leaf. This has been modified to operate either from a foot switch or a hand switch worked by an assistant who is recording. The duration of burn is the number of seconds elapsing between instant of removing leaf from "match" and the last spark of the spreading glow. This is measured either with a stop watch or by counting with the aid of a metronome. We have used the latter method because it permits counting by both operators at once and thus saves time. The leaf is ignited near the midrib in four places uniformly spaced on all leaves and is then held in a vertical position with the fire progressing toward the margin. The position in which the leaf is held is not important, but it is important that it should be the same for all tests of a given series. Sixty seconds has been adopted as the maximum since most leaves will burn from midrib to margin in about that space of time and because sixty seconds on the leaf is a satisfactory burn. Some leaves burn longer but in the interest of time saving, an arbitrary limit had to be set. Even though they burn longer they are recorded as sixty seconds.

It is very essential that all leaves be equally moist. We have accomplished this by keeping all the leaves of the series under test wrapped together in a rubber blanket for some time before the test and removing them only as fast as needed. It is also important that the tobaccos to be compared be equally fermented and aged. Comparison of tobacco tested in the spring with other plots tested in the fall will usually lead to false conclusions.

It is particularly important that the number of tests be large. Individual leaves from the same plot show wide variation in fire-holding capacity. Therefore, figures, to be significant, must be averages of a large number of tests. It is doubtful whether a conclusion based on less than a hundred tests is safe. Tests were made on all of the four principal grades of leaves and on all replications of the same treatment.

The cigar test. In this test the cured fermented leaves are used in making cigars and are then smoked. They may be used (1) as *wrapper alone* on some standard filler and binder, (2) as *wrapper and binder* on a standard filler, or (3) for *entire cigars* (clears). All three have been used in our tests. Since practically all Connecticut tobacco is used for binders and wrappers, the first two would seem to be best. A character such as aroma, however,

is not easy to judge if a foreign filler is used. At first thought, the cigar test seems much preferable to the strip test, but errors may easily arise from the improper adjustment of wrapper, binder and filler. The cigar test is essential for comparing ash color and coherence and the closeness and evenness of burn. It may supplement the test of fire-holding capacity but in this respect it cannot measure as fine differences as the strip test.

The test cigars may be smoked in the usual way, or by a mechanical intermittent smoker. The mechanical smoker is more rapid and does not suffer from over indulgence, but it cannot be used for testing taste. Also it seems to change the aroma for the worse. For testing the other characteristics, however, the mechanical smoker is just as accurate as the human one.

Fire-holding capacity is determined by stopping the machine and recording the number of minutes elapsing before the cigar stops burning as determined by absence of smoke on renewal of inhaling.

Ash color is denoted as white, light gray, medium gray, dark gray, black. Sometimes there is a brownish cast to a gray ash and it is termed "muddy." Color charts have not been found very useful because of lack of uniformity in color even on a single cigar. Ash color should not be determined on the end of the cigar but from a median section.

Some Nitrogenous Fertilizer Materials

In previous reports (Tobacco Station Bulletins 5, 6 and 8) the five-year nitrogen experiment (1922-26) has been fully discussed. The object of this old nitrogen series was to compare the effect of certain nitrogen-carriers in the fertilizer mixture, on the yield and quality of tobacco. The comparative yields have been fully tabulated and discussed in previous reports. The quality has been measured by the percentage of grades when sorted and by judgment of experts. Only brief reference has been made previously to the burning capacity of the tobacco. Such tests have now been made on the last two crops of this series.

During the first three years of the experiment no burn records were made with the exception of a small number on the crop of 1923 (Bul. 5, p. 10, 11). The number of tests, however, was entirely too small to warrant conclusions.

When the crops of 1925 and 1926 were sorted, sample "hands" of light wrappers, medium wrappers, darks and seconds were packed in regular cases (250-300 lbs. of tobacco) and fermented in the sweat rooms of commercial warehouses.[1] After the "force sweat" of about six weeks, the cases were removed to the station

[1] The writers are indebted to Mr. John Orr of Windsor Locks and Mr. W. S. Pinney of Suffield for the use of sweat rooms for this purpose.

warehouse where they were allowed to undergo a "natural sweat" during the following summer before burn tests were made in the fall. This procedure necessitates delay of a year after sorting before the test can be made and explains why reports on burn have not been presented previously. Both "strip" tests and "cigar" tests were made.

To make the strip tests, five leaves of each hand were selected and each leaf tested in four places (as previously described under "Methods"). Thus there were 20 individual tests of each grade, there were four grades of each of the triplicate plots making a total of 240 individual tests for the tobacco receiving a given treatment. Repetition on the tobacco of the two years raises the number of individual tests for each treatment to 480. This number should be sufficiently large to make the results significant. The duration of burn, in seconds, for the different treatments and the four grades of each is tabulated below (Table 1).

TABLE 1. OLD NITROGEN SERIES. FIRE HOLDING CAPACITY OF 1925–26 CROPS.
STRIP BURN TESTS

ot .	Special source of Nitrogen	Duration of Burn (seconds)										
		Dark		Mediums		Lights		Seconds		Ave. of all grades		Av. of both years
		1925	1926	1925	1926	1925	1926	1925	1926	1925	1926	
1	1/5 N. in Nitr. soda	35.7	10.6	44.4	16.2	49.1	39.8	43.2	44.0	43.7	27.7	35.4
2	½ N. in Nitr. soda	32.4	11.3	34.4	14.2	34.2	29.7	38.8	39.9	34.9	23.8	29.4
3	1/5 N. in Sulf. am.	20.2	8.7	22.6	13.5	30.8	19.0	29.5	22.9	25.8	16.0	20.9
4	½ N. in Sulf. Am.	14.4	8.2	15.7	9.5	18.1	16.9	14.8	23.1	15.7	14.3	15.0
5	All N. in Organics	15.4	9.2	16.0	14.7	17.8	21.1	18.2	27.0	16.9	18.0	17.5
6	½ N. in D.G. Fish	14.0	11.7	25.9	20.3	34.2	31.8	32.0	37.4	26.5	25.3	25.9
7	½ N. in tankage	36.9	12.1	33.4	14.2	40.1	28.1	46.4	31.3	39.2	21.4	30.3

DISCUSSION OF RESULTS OF STRIP TESTS

Effect of increasing the nitrate of soda. The N1 formula is the standard formula with which to compare all others. Tobacco produced on this formula consistently had the highest burning capacity of all the plots. One-fifth of the nitrogen was from nitrate of soda, the remainder being in cottonseed meal and castor

pomace in ratio of 3:1. No sulfate of ammonia was applied to these plots during the five years of the experiment. On the N2 plots, the same fertilizer was applied except that the nitrate of soda was increased to furnish one-half of the nitrogen (100 lbs.). The fire-holding capacity is consistently lower on these N2 plots. During the preceding 3 years of the experiment, however, the N2 plots had a fertilizer containing 260 lbs. of sulfate of ammonia per acre annually. Whether there was any "carry-over" effect of the sulfate of ammonia is not certain. The depression in burn for the second year was not as great as for the first.

Effect of sulfate of ammonia. The fertilizer mixtures used on plots N3 and N4 were identical with those used on N1 and N2 respectively except that in N3 and N4 the mineral nitrogen was in the form of sulfate of ammonia instead of nitrate of soda. N4 had the lowest fire-holding capacity of any of the plots and also had the most sulfate of ammonia applied. N3 also, which had only one-fifth of its nitrogen from sulfate of ammonia, showed a decided depression in fire-holding capacity when compared with either of the nitrate of soda plots. This consistent depression of *burn on the sulfate of ammonia plots is the most marked of any* of the differences brought out in these tests of the old nitrogen series.

Effect of omitting all mineral carriers of nitrogen. The N5 plots had all their nitrogen in the form of cottonseed meal and castor pomace during 1925 and 1926. During the preceding three years, however, these plots received all their nitrogen in mineral carriers (including 724 lbs. of sulfate of ammonia per acre annually). It is more probable that the low fire-holding capacity which they show was due to the carry-over effect of the previous high sulfate treatment rather than the use of the organics in 1925 and 1926.

Effect of dry ground fish. The treatment of the N6 plots where half of the nitrogen was from fish, has not been changed during the five years of the experiment. The burn in all grades is consistently somewhat lower than for the N1 plots with which it should be compared. Apparently fish also has a depressing effect on burn although not as marked as that shown by sulfate of ammonia.

Tankage. The treatment of the tankage plots also has not been changed during the five years. Although the final average is five seconds below that of the N1 plots the differences were not so consistent nor so large as between the others.

CIGAR TESTS

For cigar tests, an experienced cigar maker used the seconds and light wrappers for each plot (1) as binder and wrapper on a standard filler and (2) as filler, binder and wrapper ("clears"). Some were smoked in the usual way, others by means of the automatic smoking apparatus described above.

Fire holding capacity. With but a few exceptions all cigars easily held fire for five minutes. The longest was nine minutes. The highest fire-holding capacity was possessed by cigars from the N1, N2, and N7 plots, the lowest by N3, 4, 5. In this respect it agreed fairly well with the strip tests.

Ash color. Differences between treatments were more marked in the color of the ash than in any other respect. N1 had the best color, usually light gray with an occasional medium. The N7 cigars were mostly as light as the N1 but threw some darks. N2 was medium gray. The ash of N3, 4, and 5, was unsatisfactory, being mostly dark muddy gray with a few mediums.

Coal band was best on N1, 2, 6, 7, but was broad and inclined to indefinite "coaling" on N3 and 4. Also in evenness, N3 and N4 were the poorest.

Coherence was good for all treatments. There was no flaking, splitting or crumbling in any of them.

The correlation of burn characters is well illustrated by comparison of the N1 burn with N4. N1 possesses the combination of high fire holding capacity, light ash, and a close and even burn. Contrasted with this is N4 with low fire-holding capacity, dark ash, uneven burn with broad coal band. This correlation has prevailed throughout all our tests.

SINGLE SOURCES OF NITROGEN

In another series of plots, started in 1926, four nitrogenous fertilizer materials were compared by using each as the *only* source of nitrogen on one of four plots on another field. The plots were one-fortieth acre in size. All other ingredients of the mixture except the nitrogen carrier were the same. A sufficient ration of potash and phosphoric acid was supplied to avoid any shortage. The four carriers were cottonseed meal, nitrate of soda, sulfate of ammonia and synthetic urea. After the same period of force sweat and natural sweat as previously mentioned for the other tobacco, burn tests were made; twenty tests of each grade. The results are presented in Table 2.

TABLE 2. SINGLE NITROGEN CARRIER SERIES. CROP OF 1926. STRIP BURN TESTS.

Plot No.	Nitrogen Carrier	Duration of Burn in Seconds.				
		Darks	Mediums	Lights	Seconds	Ave
N11	C. S. Meal	11.5	34.7	39.8	50.0	34.0
N12	Nitr. Soda	13.3	48.2	38.1	48.5	37.0
N13	Sulf. Am.	10.0	14.8	28.4	30.0	20.8
N14	Urea	14.9	29.7	35.5	34.8	29.0

This table shows again the marked depression in the fire-holding capacity resulting from sulfate of ammonia. This is evident in all grades.

The nitrate of soda plot showed no depression but a somewhat better burn than cottonseed alone. Tobacco from the urea plot did not burn quite as well as from the cottonseed plot. Since, however, this was the first year of the series and since the plots were not replicated, it is best not to draw conclusions except from large and consistent differences. The table is included here because it corroborates the conclusion drawn from the old nitrogen series as to the injurious effect of sulfate of ammonia on burn.

ADDITIONAL EVIDENCE ON EFFECT OF SULFATE OF AMMONIA

Additional support for the same conclusion is afforded by results of a third set of experiments in which the effect of acid and alkaline fertilizers on soil reaction and prevalence of black rootrot is under test. The composition of the acid, alkaline, and neutral fertilizer mixtures is as follows:

ACID FERTILIZER (PLOT T1a AND T1b).

Material	Lbs. per Acre	Plant nutrients per acre		
		NH_3	P_2O_5	K_2O
Ammonium sulfate	440	110.0		
Cotton seed meal	1100	90.2	31.9	16.5
Precipitated bone	333		128.1	
Sulfate of potash	367			183.5
Total	....	200.2	160.0	200.0

ALKALINE FERTILIZER (PLOT T2a AND T2b).

Material	Lbs. per Acre	Plant nutrients per acre		
		NH_3	P_2O_5	K_2O
Nitrate of soda	585	110.0		
Cotton seed meal	1100	90.2	31.9	16.5
Precipitated bone	333		128.1	
Carbonate of pot.	282.3			183.5
Total		200.2	160.0	200.0

General Formula (Plot T3a and T3b).

Material	Lbs. per Acre	Plant nutrients per acre		
		NH_3	P_2O_5	K_2O
Cotton seed meal	1463.4	120.0	42.4	21.9
Castor pomace	588.2	40.0	10.6	5.9
Nitrate of soda	105.5	19.83		
Ammophos (urea in 1927)	103.1	20.17	22.41	
Precipitated bone	220.0		84.6	
Sulfate of potash	172.2			86.1
Carbonate of potash	132.3			86.1
Total.		200.0	160.5	200.0

These mixtures have been applied annually, starting with 1924 to the same three plots. In addition, one-half of each plot was heavily limed each year.

It will be noted that the acid fertilizer contains a large quantity of sulfate of ammonia while the alkaline fertilizer contains sufficient nitrate of soda to furnish the same amount of nitrogen.

Results of burn tests on the crops of 1925 and 1926 are presented in Table 3.

Table 3. Rootrot Series. Crops of 1925, 1926.
Strip Burn Tests.

lot lo.	Character of Fertilizer	Lime Treatment	Duration of Burn (In Seconds)								All Gra	
			Darks		Mediums		Lights		Seconds		Average	
			1925	1926	1925	1926	1925	1926	1925	1926	1925	1926
1	Acid	yes	18.4	.....	.....	12.1	.....	9.7	7.3	8.4	13.7	14.8
		no	10.8	.....	18.9	15.9	12.3	28.9	14.7	13.9	.....	.....
2	Alkaline	yes	30.2	.....	37.4	29.8	32.9	25.8	23.1	22.1	35.4	33.2
		no	29.8	.....	38.7	27.6	43.3	45.1	48.7	48.9	.....	.....
3	Neutral	yes	37.1	.....	28.6	15.0	12.5	17.8	17.9	22.6	32.5	29.1
		no	39.4	.....	39.3	30.3	28.7	45.0	39.1	40.2	.....	.....

Here again the burn was reduced to less than one-half of the fire-holding capacity of the other plots when large quantities of sulfate of ammonia were used.

The fact that sulfate of ammonia applied in the fertilizer under these conditions injures the burn, is thus fairly well established but the reason for this effect has not been fully determined. The first explanation that would occur to one is that it increases the sulfur content of the leaf. Garner found sulfates to be injurious to burn.[1] The chemical analyses of tobacco from these plots (p. 45) does show some increase in the sulfur absorbed. The

[1] U. S. D. A. Bur. Pl. Indus. Bul. 105, p. 18. 1907.

analyses show no significant differences in quantity of total nitrogen, nitrate nitrogen or ammonia nitrogen. As will be shown in a later page in this bulletin, sulfate of ammonia has in every case made the soil more acid. It is conceivable that the acid condition is indirectly the cause of poor burn since it causes changes in the solubility of certain soil elements and affects the nutrition of the tobacco plants.

Sulfate of ammonia is not used very extensively for a tobacco fertilizer but assumes importance for two reasons: (1) it has been used as a cheap source of nitrogen in some mixed goods where the manufacturer is not required to reveal the constituents of the mixture and (2) it is being used by some growers with the object of making the land more acid where rootrot has become prevalent. It may be anticipated in either case, its use will be attended by some impairment of burn.

UREA

The urea series was begun in 1925 with six plots on Field IX. Two plots received the standard formula which contains no urea and in which all the nitrogen is in cottonseed meal, castor pomace and nitrate of soda. Two other plots received the same mixture except that one-half of the nitrogen was from urea. On the last two plots, *all* the nitrogen of the formula was in urea. Except for the quantity of urea, all the fertilizer formulas were the same.

Burn tests were made on the samples of the 1925 crop in the spring before they had a chance to go through the natural summer sweat. This is reflected in the low burn capacity as compared with that of the 1926 crop. Tests of the latter were made after the summer sweat. The tests of both years are presented in Table 4.

TABLE 4. UREA SERIES. CROP OF 1925-26.
STRIP BURN TESTS.

Quantity of Urea	Duration of Burn (Seconds).										
	Darks		Mediums		Lights		Seconds		All grades		[illegible]
	1925	1926	1925	1926	1925	1926	1925	1926	1925	1926	[illegible]
No urea	13.9	9.3	15.2	21.1	11.9	40.0	22.5	33.0	15.9	25.8	[illegible]
½ N. in urea	18.8	8.3	18.6	17.5	24.8	33.3	22.9	36.1	21.3	24.0	[illegible]
All N in urea	10.7	11.3	19.6	22.5	19.2	26.9	17.9	37.4	17.0	24.5	[illegible]

Each figure in the extreme right hand column is the average of 320 individual burn tests. A study of this table does not show any significant differences in burn corresponding to the different quantities of urea used.

"Cigar tests" were made on tobacco from all the urea plots and from the two adjacent checks. There were no significant differ-

ences in the fire-holding capacity, evenness or closeness of burn, nor in coherence of ash. In the color of ash, however, the cigars from the urea plots were somewhat superior to the check plots, being mostly very light gray to white. There was no tendency to flaking in any of them. No explanation of this whiteness of the urea cigars is apparent.

Potash Salts

Experimental field plots for the purpose of comparing different carriers of potash have been grown on the station farm since 1923. The results of the tests are recorded in Bulletins 5, 6, and 8, of the Tobacco Station. There are four series of these, located on different parts of the farm.

Double sulfate of potash-magnesia. The first series consists of a block of six plots which were begun in 1923 for the purpose of comparing high grade sulfate of potash with double sulfate of potash-magnesia. The two K1 plots were fertilized with the standard ration which has all the mineral potash in the form of high grade sulfate; the K2 plots had an equal amount of potash in form of double manure salts while the K3 plots had the same amount of potash divided equally from the two sources. No changes in location of plots have been made during the five years of the experiment. Burn tests were made on the crops of 1925 and 1926. Results of the strip burn tests are presented in Table 5.

'ABLE 5. Double Manure Salts *vs.* High Grade Sulfate As Source of P(
Strip Burn Tests On Crops of 1925, 1926.

lot o.	Source of Potash	Duration of Burn in Seconds.									
		Darks		Mediums		Lights		Seconds		All grades	
		1925	1926	1925	1926	1925	1926	1925	1926	1925	1926
1	H. Grade Sulfate	36.4	14.9	25.8	16.4	52.9	36.7	36.1	44.0	37.8	28.0
2	Double Manure Salts	23.4	10.6	25.9	16.8	36.4	30.1	28.7	41.4	28.6	24.7
3	One half from each	25.7	15.4	24.2	18.3	48.9	33.6	39.5	32.7	34.6	25.0

Each of the figures in the right hand column is an average of 320 tests. A study of this table shows a small but very consistent drop in the fire-holding capacity through the use of the double salt to replace high grade sulfate. When a mixture of the two was used, the fire-holding capacity was exactly intermediate between the others. The constancy of these differences leads us to conclude that the use of sulfate of potash-magnesia is detrimental to the burn of tobacco. Since no chemical analyses of the tobacco from

these plots has yet been made we are not in a position to offer an explanation of this effect. The first explanation which would occur to one is that it was due to an increase either in the magnesia or the sulfate content of the leaf.

Muriate. The injurious effect of muriate of potash has been demonstrated experimentally in various tobacco sections but in the Connecticut Valley no data on this point are on record previous to the experiments described in our report for 1926. This experiment was continued for two years. Burn tests as compared with adjacent check plots where the fertilizer was identical except for the use of sulfate instead of muriate are recorded in Table 6.

TABLE 6. MURIATE *vs.* SULFATE OF POTASH.
STRIP BURN TESTS OF CROPS OF 1925 AND 1926

Source of Potash	Duration of Burn in Seconds									
	Darks		Mediums		Lights		Seconds		All grades	
	1925	1926	1925	1926	1925	1926	1925	1926	1925	1926
Muriate	3.6	4.2	5.6	6.7	5.6	4.9	4.6	8.6	4.9	6.1
Sulfate	35.7	10.6	29.1	16.2	49.1	39.8	43.2	44.0	43.1	27.7

The results are so overwhelmingly adverse for muriate that there could be no question as to its ruinous effect on burn when used to supply 172 lbs. of potash per acre (about 150 lbs. chlorine). On another part of the same field, plots, where 53 lbs. of chlorine are applied annually, are included in some experiments in cooperation with the United States Department of Agriculture. Mr. H. F. Murwin, in charge, found that this smaller amount was also very deleterious to the burn.

Carbonate and Nitrate of Potash. This set of ten plots on Field V was started in 1925 with the object of comparing carbonate, nitrate and sulfate of potash. Plots were in duplicate in 1925 and 1926 but the experiment enlarged in 1927 to make five replications of each treatment. Burn tests were made on the crops of 1925 and 1926 and are recorded in Table 7.

TABLE 7. CARBONATE, NITRATE AND SULFATE OF POTASH.
STRIP BURN TESTS ON CROPS OF 1925 AND 1926.

Source of Potash	Duration of Burn (Seconds)									
	Darks		Mediums		Lights		Seconds		All Grades	
	1925	1926	1925	1926	1925	1926	1925	1926	1925	1926
Sulfate	34.0	27.9	30.8	41.5	46.4	54.6	32.1	52.9	35.8	44.2
Carbonate	41.5	22.8	40.7	54.5	50.4	59.1	47.4	58.8	45.0	48.8
2/3 Nitrate 1/3 carbonate	27.2	16.7	51.3	39.4	44.2	54.7	49.8	54.9	43.1	41.4
½ carbonate ½ sulfate	40.2	19.1	25.3	49.1	44.7	51.7	41.8	48.3	38.0	42.3
1/3 sulfate 1/3 carbonate 1/3 nitrate	44.6	26.5	43.3	50.6	38.8	57.9	45.0	47.7	42.9	45.2

The differences in fire-holding capacity of the different plots : small. Of the three carriers, carbonate ranks first, nitrate secoı and sulfate third. A combination of the three carriers, howev gave almost as good results as carbonate.

QUANTITY OF PHOSPHORUS

On the phosphorus series, four different quantities of ph phoric acid per acre were applied annually for five years. 1 four plots were in triplicate. During the fourth and fifth yea the only special carrier of phosphorus was precipitated bone. Dı ing the preceding three years a mixture of precipitated bone a superphosphate was used on the P1 plots. The amount of ph phoric acid applied per acre is given in Table 8. The 53 lbs. the P2 formula were in the cottonseed meal and castor pomace the formula. There were no special phosphorus carriers. Bı tests were made on the crops of the fourth and fifth year and : presented in the same table. Each figure in the right hand coluı is the average of 480 tests.

TABLE 8. PHOSPHORUS SERIES.
STRIP BURN TESTS. CROPS OF 1925 AND 1926.

Plot No.	Lbs. P_2O_5 per acre	Duration of Burn Seconds.									
		Darks		Mediums		Light		Seconds		All Gra	
		1925	1926	1925	1926	1925	1926	1925	1926	1925	1'
P2	53	26.0	12.5	26.7	20.7	39.4	30.3	53.9	37.2	36.5	2
P3	100	31.9	16.1	31.1	19.2	37.8	31.3	44.8	38.6	36.4	2
P1	160	19.6	8.4	19.7	14.0	25.5	34.1	28.8	34.0	23.4	2.
P4	200	21.6	8.8	26.6	18.9	26.9	25.4	34.5	34.9	27.4	2.

It is apparent from these tests that the two plots which received the smaller quantity of phosphorus produced tobacco with the highest fire-holding capacity. Those two which received the heavy applications of phosphorus show a consistent depression in fire-holding capacity. These results lead us to believe that heavy applications of phosphorus to old tobacco land may affect to some extent the fire-holding capacity of the tobacco and should be avoided. In view of the fact that chemical analyses fail to show greater absorption of phosphorus by tobacco on the high phosphorus plots it is not easy to explain this effect.

For a full discussion of the phosphorus experiment, the reader is referred to Tobacco Station Bulletin 7.

When "cigar tests" were made, there were no differences apparent in fire-holding capacity or ash characters.

Lime

Heavily limed plots on three different fields afford an opportunity to test the effect of lime on burn.

Lime series on Station Field VIII. Beginning with 1922 these plots were limed heavily each year. With the last application in spring of 1925 they had received five tons of hydrated lime per acre, and the reaction of the soil was somewhat above 7.0 pH. In Table 9 the burn of the tobacco from these plots is compared with the check plots of the urea series on one side and with the check plots of the manure and cover crop plots on the other. These checks had the same fertilizer treatment as Field VIII and were immediately adjacent to it but were never limed.

Table 9. Lime Plots.
Strip Burn Tests.

Plot No.	Lime Treatment	Duration of Burn in Seconds.								
		Darks		Mediums		Lights		Seconds		Avrg.
		Thielavia Series 1925–1926								
		1925	1926	1925	1926	1925	1926	1925	1926	
T1, 2, 3a	Lime	28.5	.....	33.0	18.9	22.7	17.8	16.1	17.7	22.1
T1, 2, 3b	No lime	26.7	.....	32.3	24.6	28.1	39.7	34.2	34.3	31.4
		Lime Series on Field VIII. 1926.								
L	Lime	22.5		27.8		26.1		20.7		22.5
C3, 5, 14	No lime	15.8		29.0		37.8		38.5		30.3
N1	No lime	9.3		21.1		40.0		33.0		25.8
		Lime Series on Poquonock Field 1926.								
4H, 14A	Lime	20.9		20.1		12.1		10.6		15.9
6A, 14B 15A	No Lime	26.8		39.2		37.1		42.7		36.4

The results show that the tobacco from the checks on either side of the limed plots burned longer than the limed tobacco.

Thielavia series. On this series, which has been mentioned previously in connection with the sulfate of ammonia tests, one half of each of three plots was limed annually at a rate of one ton hydrated lime per acre. Tests on the crops of 1925 and 1926 are recorded in Table 9. Here again there is a distinct depression in fire-holding capacity from the heavy use of lime.

Poquonock series. In some field experiments on brown rootrot at Poquonock, two plots were limed annually at same rate as the Thielavia plots beginning in 1925. Tests on the tobacco from these and from adjacent unlimed plots are included in Table 9 and show that here again there was a distinct lowering of the fire-holding capacity from lime.

From the results of these three independent series of tests it is apparent that lime applied in large quantity reduces the fire-holding capacity as measured by the strip test.

Cigar tests. Cigars were made from the lime series of 1925 but not from the other series. These were compared with the checks of the urea series and manure series. The lime-treated tobacco gave the most perfect burn of any of the cigars from the crop of 1925. The ash color was mostly pure white or at most a very light gray. The coal band was extremely narrow and even. There was a slight tendency to flaking of the ash but it was not objectionable. The fire-holding capacity was also the best of any of the cigars, this being the only lot which would hold fire for ten minutes. This is not easy to explain in view of the injurious effect which the lime had in the strip burn tests of tobacco from the same plots.

Summary

1. Sulfate of ammonia seriously lowered the fire-holding capacity both when tested by the strip test and when the cigar test was used. Dark muddy ash, uneven burn and coaling also characterized the cigar test.

2. Large quantities of dry ground fish in the mixture also lowered the fire-holding capacity but not so much as the sulfate of ammonia.

3. Tankage had no pronounced effect.

4. Results with nitrate of soda were not entirely conclusive but did not indicate serious, if any, impairment of burn.

5. Urea did not affect the fire-holding capacity but increased the whiteness of ash.

6. Large quantities of phosphorus lowered fire-holding capacity on strip test but made no difference in the cigar test.

7. Muriate of potash almost destroys the fire-holding capacity.

8. Double sulfate of potash-magnesia lowered the fire-holding capacity when compared with high grade sulfate.

9. Comparing nitrate, carbonate and sulfate of potash, the differences in fire-holding capacity were not large but two years' results ranked carbonate first, nitrate second, and sulfate third. Ash characters were in the same order.

10. Lime in large amount reduced the fire-holding capacity when tested on the leaf. On the cigar, however, the fire-holding capacity was good. From the standpoint of whiteness of ash, closeness and evenness of burn, the cigars from the lime plots ranked highest.

CHEMICAL ANALYSES OF TOBACCO FROM THE NITROGEN PLOTS

*E. M. Bailey and P. J. Anderson**

The analytical data reported here were obtained upon tabacco grown upon a series of experimental plots referred to in this, and in previous publications, as the "old nitrogen series". Many data are already available upon the composition of tobacco leaf grown under various conditions, particularly with varying applications of nitrogenous and other fertilizers, but because of the rather complete history of these plots as regards fertilizer applications for a number of years past, it was felt that analyses of the leaf, in addition to their present interest, would be of value for reference in future work. The chief purpose of these analyses is to show what differences, if any, in leaf composition might be found where nitrogen was supplied in equal amounts but in varying forms. Then too, since the tobaccos from these plots have shown decided differences in leaf quality, burn for example, it was thought that analyses might show certain correlations between composition and burning quality which would, at least, be suggestive. No doubt many factors are involved in the explanation of satisfactory or unsatisfactory burning capacity, and the difficulties of postulating such qualities in terms of chemical composition of leaf are recognized. Interpretations based upon the composition of the entire leaf may be further complicated due to the unequal distribution of certain constituents between midrib and the remainder of the leaf. These and other considerations probably led to the so-called "synthetic" method of approaching the problem of burn by which tobacco is

* With the collaboration of Messrs Fisher, Nolan and Mathis to whom credit for the analytical work involved is due.

directly treated with various chemicals and the resultant effects upon burning quality noted.

The analyses herein reported are of the leaf as a whole. Sample hands were taken from each plot and each of the four grades when the tobacco was sorted. These hands were fermented and aged as already described in the discussion of burn tests. It was not thought necessary to analyze all of the four grades of each plot. The two most distinct grades were therefore selected, *viz.*, dark wrappers and light wrappers. The dark wrappers are the heavier leaves from the tops of the plants. The grade which is called "lights" in these analyses was not always of sufficiently good quality for that grade; in some cases the long seconds were substituted, particularly in the crop of 1926, but the position on the plant is in all cases the same, i.e., well toward the bottom but above the sand leaves and short seconds.

Methods of Analysis

The moist leaves as received were air-dried and the air-dry material analyzed. Woody butts of leaves were removed but the midribs were left intact. The air-dry material was ground to pass a 1/25 in. sieve and the ground material preserved in tightly stoppered containers. The methods of analysis employed were those as described in Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists,[1] but the following additional comments may be made.

Nitrogen. Total nitrogen was determined by the Kjeldahl method modified to include the nitrogen of nitrates. Nitrate nitrogen was determined by the reduced iron method, distilling with magnesium oxide, and making a correction for the nitrogen due to the action of sulphuric acid upon organic material.[2] Nicotine nitrogen was calculated from nicotine as determined by the silicotungstic acid method. The determination of nitrogen in ammonium salts by the usual method of distillation with magnesium oxide gives results which are not reliable as evaluations of ammoniacal nitrogen because of the interference of nicotine which distills over under the conditions imposed by the method. In order to determine the effect of nicotine upon the distribution of nitrogen as determined by the usual methods, solutions of ammonium sulphate, nitrate of soda and nicotine citrate of definite concentrations were prepared and determinations of total nitrogen, ammoniacal nitrogen and nitrate nitrogen made. The results obtained are summarized as follows:

[1] Chapter IV, pg. 39 et seq.
[2] Jour. Assoc. Offi. Agr. Chemists. **11**, 32, 1928.

Influence of Nicotine On Nitrogen Distribution

Material		Total Nitrogen gm.	Nitrogen In Ammonia gm.	Nitrogen In Nitrate gm.
Ammonium sulphate	present, calc.	0.0080	0.0080	0.0000
	found	0.0080	0.0081	0.0002
Sodium nitrate	present, calc.	0.0144	0.0000	0.0144
	found	0.0146	0.0000	0.0140
Nicotine citrate	present, calc.	0.0061	0.0000	0.0000
	found	0.0063	0.0020	-0.0006
Ammon. sulph.+ Sodium nitrate	present, calc.	0.0224	0.0080	0.0144
	found	0.0224	0.0080	0.0135
Ammon. sulph+ Nicotine citr.	present calc.	0.0141	0.0080	0.0000
	found	0.0140	0.0098	-0.0002
Sodium nitrate+ *Nicotine sulph.*	*present, calc.*	0.0205	0.0000	0.0144
	found	0.0200	0.0020	0.0135
Ammon. sulph.+ Sodium nitrate+ Nicotine citrate	present, calc.	0.0285	0.0080	0.0144
	found	0.0281	0.0098	0.0133

Aliquots were taken so that the amounts of the several materials approximate percentages of the magnitude found in our analyses of tobacco. It is evident from these results that total nitrogen and nitrate nitrogen are accurately evaluated in mixtures of these three substances, but that results for nitrogen in *ammonium* salts are too high due to the presence of nicotine. Under the conditions of uniform technique, which was the same as employed in the analyses of tobacco reported here, ammoniacal nitrogen is enhanced by about 0.2 per cent due to nicotine. Under other conditions (longer distillation for example), the error due to nicotine may be increased. In the determination of nitrate nitrogen by the method here employed the value for "ammoniacal" nitrogen is involved as a corrective factor, but however imperfect this factor may be as an expression of ammonia it does not vitiate the evaluation of nitrate nitrogen. Nicotine was determined by distilling with sodium hydroxide and precipitating nicotine in the distillate by means of silicotungstic acid.

Sulphur was determined by the tentative magnesium nitrate method. Sulphate sulphur was determined by digesting the tobacco with 1 per cent hydrochloric acid at room temperature for three hours in a shaking machine and precipitating sulphate in the

filtered solution with barium chloride, also at room temperature. Sulphate sulphur was calculated from the barium sulphate obtained.[1]

Summaries of Analytical Data

Complete analyses were made on both the dark and light leaves of the 21 plots of the 1925 crop. The data from triplicate plots which received the same fertilizer treatment were averaged and are presented in Table 10. The significant differences in the nitrogen fertilizer treatments are noted in the column headings of this table.[2]

Supplementing Table 10 is Table 11, which gives results obtained on the 1926 crop from the same plots as are represented for the previous year. These data are to check or to amplify certain points of particular interest suggested by the results obtained on the 1925 crop.

It should be noted that in the selection of leaves for the 1926 series (Table 11), seconds were used in most cases instead of lights. As seconds are lower down on the stalk than the lights the differences in composition shown in certain instances must be interpreted with this reservation in mind.

And finally in order to facilitate comparisons of several groups with reference to separate constituents, or groups of constituents, the data are rearranged and summarized for that purpose in the series of tables beginning with Table 12a.

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[1] Ohio Agr. Exp. Station. Bull. 285. 1915.

[2] Conn. Agr. Exp. Station. Tobacco Station Bull. 6, 1926, gives a complete statement of fertilizer mixtures used.

TABLE 10. COMPLETE ANALYSES OF SAMPLES FROM THE CROP OF 1925 (AVERAGES OF TRIPLICATES, MOISTURE-FREE BASIS).

	N 1 Plots 1/5 N. in Nitr. Soda			N 2 Plots ½ N. in Nitr. Soda			N 3 Plots 1/5 N. in Sulf. Am.			N 4 Plots ½ N. in Sulf. Am.			N 5 Plots All N. in Organics			N 6 Plots ½ N. in Fish			N 7 Plots ½ N. in Tankage		
	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ash, total	25.77	28.01	26.89	23.32	27.55	25.44	25.74	29.32	27.53	25.49	27.00	26.25	24.37	26.80	25.59	24.83	27.39	26.14	24.58	27.62	26.10
Sand + SiO_2, sol.	1.82	1.27	1.55	1.02	1.60	1.31	1.15	1.62	1.39	0.96	1.30	1.13	1.00	1.40	1.20	1.00	1.32	1.16	1.08	1.38	1.23
Fe_2O_3 + Al_2O_3	0.19	0.17	0.18	0.19	0.25	0.22	0.18	0.22	0.20	0.21	0.21	0.21	0.17	0.21	0.19	0.27	0.23	0.25	0.20	0.24	0.22
CaO	5.85	6.53	6.19	5.41	6.69	6.05	5.76	6.70	6.23	6.42	7.71	7.07	6.42	7.57	7.00	6.26	7.23	6.75	6.14	7.23	6.69
MgO	0.98	0.99	0.99	0.75	0.73	0.74	0.78	0.79	0.79	0.84	0.89	0.87	0.81	0.78	0.80	0.81	0.83	0.82	0.99	0.93	0.96
Mn_3O_4	0.07	0.05	0.06	0.05	0.06	0.06	0.16	0.23	0.20	0.17	0.22	0.20	0.22	0.31	0.27	0.09	0.11	0.10	0.09	0.10	0.10
K_2O	7.91	8.28	8.10	7.24	8.63	7.94	8.26	9.40	8.83	7.85	8.15	8.00	7.60	8.13	7.87	7.52	8.54	8.03	7.75	8.64	8.20
P_2O_5	0.85	0.70	0.78	0.75	0.69	0.72	0.83	0.83	0.83	0.87	0.75	0.81	0.78	0.73	0.76	0.68	0.62	0.65	0.80	0.64	0.72
S, total	0.75	0.68	0.72	0.74	0.74	0.74	0.84	0.84	0.84	0.97	0.90	0.94	0.79	0.81	0.80	0.74	0.70	0.72	0.75	0.70	0.73
S in ash	0.66	0.63	0.65	....	....	0.69	....	....	0.78	....	....	0.85	0.76	0.72	0.74	....	....	0.67	....	....	0.61
Cl	0.44	0.37	0.41	0.51	0.46	0.49	0.57	0.48	0.53	0.46	0.34	0.40	0.46	0.34	0.40	0.60	0.57	0.59	0.76	0.60	0.68
N. total	4.74	3.92	4.33	4.54	3.88	4.21	4.78	3.94	4.36	4.87	4.05	4.46	4.90	4.25	4.58	4.70	3.91	4.30	4.76	3.87	4.32
N. as ammon.	0.82	0.49	0.66	1.00	0.51	0.76	0.85	0.46	0.66	0.90	0.53	0.72	0.82	0.54	0.68	0.82	0.50	0.66	0.81	0.49	0.65
N. as nitrate	1.02	1.28	1.15	0.93	1.30	1.11	0.98	1.30	1.14	1.01	1.33	1.17	1.07	1.48	1.27	1.07	1.36	1.22	0.92	1.32	1.12
Nicotine	3.10	2.26	2.68	3.01	2.23	2.62	2.91	1.84	2.38	3.08	2.28	2.68	2.74	2.11	2.43	3.04	2.12	2.58	3.18	2.29	2.74
N. in nicotine	0.54	0.39	0.47	0.52	0.39	0.46	0.50	0.32	0.41	0.53	0.39	0.46	0.47	0.36	0.42	0.52	0.36	0.44	0.55	0.39	0.47

TABLE 11. ANALYSES OF SAMPLES FROM THE CROP OF 1926
(AVERAGES OF TRIPLICATES, MOISTURE-FREE BASIS)

	N 1 Plots 1/5 N. in Nitr. Soda			N 2 Plots ½N. in Nitr. Soda			N 3 Plots 1/5 N. in Sulf. Am.			N 4 Plots ½ N. in Sulf. Am.			N 5 Plots All N. in Organics			N 6 Plots ½ N. in Fish			N 7 Plots ½ N. in Tankage		
	Dark	Sec-onds	All	Dark	Sec-onds	All	Dark	Sec-onds	All	Dark	Sec-onds	All	Dark	Sec-onds	All	Dark	Sec-onds	All	Dark	Sec-onds	All
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
sh, total	24.83	27.36	26.08	24.08	29.13	26.61	24.45	28.79	26.62	25.30	28.19	26.75	25.18	28.31	26.74	25.40	29.26	27.33	24.99	29.03	27.01
l_2O_3	0.05	0.09	0.07	0.04	0.08	0.06	0.08	0.14	0.11	0.08	0.11	0.09	0.08	0.13	0.10	0.07	0.06	0.07	0.04	0.04	0.04
n_3O_4	0.16	0.14	0.15	0.14	0.13	0.14	0.28	0.29	0.29	0.35	0.39	0.37	0.38	0.36	0.37	0.17	0.18	0.18	0.16	0.19	0.18
total	0.79	0.73	0.76	0.84	0.66	0.75	1.08	0.84	0.96	1.04	0.89	0.96	0.95	0.75	0.85	0.87	0.76	0.82	0.79	0.69	0.74
as sulphate	0.75	0.66	0.71	0.69	0.56	0.62	0.96	0.79	0.88	0.98	0.75	0.86	0.80	0.62	0.71	0.75	0.62	0.69	0.67	0.55	0.61
organic	0.04	0.07	0.05	0.15	0.10	0.13	0.12	0.05	0.08	0.06	0.14	0.10	0.15	0.13	0.14	0.12	0.14	0.13	0.12	0.14	0.13
, total	5.56	4.49	5.03	5.57	4.12	4.85	5.74	4.14	4.94	5.59	4.44	5.01	5.68	4.39	5.04	5.58	4.38	4.98	5.70	4.13	4.92
, as ammon.	1.25	0.75	1.00	1.26	0.58	0.92	1.37	0.55	0.96	1.26	0.61	0.94	1.16	0.57	0.87	1.20	0.54	0.87	1.19	0.58	0.92
, as nitrate	1.11	1.26	1.19	1.03	1.27	1.15	0.93	1.15	1.03	0.94	1.19	1.06	1.18	1.41	1.30	1.20	1.34	1.27	1.13	1.23	1.18

Discussion of Analytical Data

Total ash. Sand and soluble silica. These constituents for the several plots are summarized in Table 12a. Total ash is higher in the light leaves than in the dark, as would be expected since the light leaves contain considerably more of both calcium and potash than is found in leaves higher up on the stalk. In the 1926 crop it appears that the ash of the dark leaves is nearly the same as that of the corresponding leaves of the previous crop; but the seconds (lower on the stalk than lights), are somewhat higher in ash, on the average, than the leaves immediately above (lights), of the year before. The differences between the several plots with respect to ash are not great enough to be of significance.

Table 12a. Comparison of Groups by Constituents. (Averages, Moisture-free Basis).

Plots	Total Ash						Sand and Soluble Silica, SiO_2		
	1925 Crop			1926 Crop			1925 Crop		
	Dark	Light	All	Dark	Second	All	Dark	Light	All
	%	%	%	%	%	%	%	%	%
N1	25.77	28.01	26.89	24.83	27.36	26.08	1.82	1.27	1.55
N2	23.32	27.55	25.44	24.08	29.13	26.61	1.02	1.60	1.31
N3	25.74	29.32	27.53	24.45	28.79	26.62	1.15	1.62	1.39
N4	25.49	27.00	26.25	25.30	28.19	26.75	0.96	1.30	1.13
N5	24.37	26.80	25.59	25.18	28.31	26.74	1.00	1.40	1.20
N6	24.83	27.39	26.14	25.40	29.26	27.33	1.00	1.32	1.16
N7	24.58	27.62	26.10	24.99	29.03	27.01	1.08	1.38	1.23
Maximum	25.77	29.32	27.53	25.40	29.26	27.33	1.82	1.62	1.55
Minimum	23.32	27.00	25.44	24.08	27.36	26.08	0.96	1.27	1.13
Average	24.87	27.67	26.28	24.89	28.58	26.73	1.15	1.41	1.28

Sand and soluble silica are a little higher in light leaves as shown by the averages and, generally by the separate plots. The differences are not striking but they are in the expected direction. If the results for total ash be corrected for sand and soluble silica the differences in ash already noted remain of about the same magnitude and in the same direction.

Iron and aluminum, and manganese. The results for these constituents are summarized in Table 12b. In the 1925 crop, iron and aluminum were determined together and there are practically no differences either between dark leaves and light or between the several plots. In the crop of the succeeding year, aluminum was determined separately. Considering the magnitude of the values involved, the differences are not very striking; but plots 3, 4 and 5 as a group are higher in aluminum than the others. The soil of these three plots was relatively more acid than that of the other plots.

TABLE 12b. COMPARISON OF GROUPS BY CONSTITUENTS. (AVERAGES, MOISTURE-FREE BASIS).

Plots	Iron and Aluminum $Fe_2O_3 + Al_2O_3$ 1925 Crop			Aluminum Al_2O_3 1926 Crop			Manganese Mn_3O_4 1925 Crop			Manganese Mn_3O_4 1926 Crop		
	Dark	Light	All	Dark	Second	All	Dark	Light	All	Dark	Second	All
	%	%	%	%	%	%	%	%	%	%	%	%
N1	0.19	0.17	0.18	0.05	0.09	0.07	0.07	0.05	0.06	0.16	0.14	0.15
N2	0.19	0.25	0.22	0.04	0.08	0.06	0.05	0.06	0.06	0.14	0.13	0.14
N3	0.18	0.22	0.20	0.08	0.14	0.11	0.16	0.23	0.20	0.28	0.29	0.29
N4	0.21	0.21	0.19	0.08	0.11	0.09	0.17	0.22	0.20	0.35	0.39	0.37
N5	0.17	0.21	0.19	0.08	0.13	0.10	0.22	0.31	0.27	0.38	0.36	0.37
N6	0.27	0.23	0.25	0.07	0.06	0.07	0.09	0.11	0.10	0.17	0.18	0.18
N7	0.20[1]	0.24	0.22	0.04	0.04	0.04	0.09	0.10	0.10	0.16	0.19	0.18
Maximum	0.27	0.25	0.25	0.08	0.14	0.11	0.22	0.31	0.27	0.38	0.39	0.37
Minimum	0.17	0.17	0.18	0.04	0.04	0.04	0.05	0.05	0.06	0.14	0.13	0.14
Average	0.20	0.22	0.22	0.06	0.10	0.08	0.12	0.15	0.14	0.23	0.24	0.24

[1] Single analysis.

There are no conspicuous differences in manganese content between the dark leaves and light leaves or dark leaves and seconds of the two years. Between plots however it is seen that 3, 4 and 5 are decidedly higher than the other plots in both years. The leaves of these plots showed the poorest burning qualities in both series of tests for the two years. To what extent, if any, manganese contributes to this result remains to be determined, but the association of the two features is of more than passing interest. So far as shown by these analyses manganese is the only element, with the exception of sulphur, (and possibly aluminum) which shows any distinct correlation with burning quality.

Calcium and Magnesium. The results for these elements are summarized in Table 12c. Light leaves are noticably higher in calcium than the dark leaves, but as regards magnesium, there are no differences, either between the leaves of the same plot or between the various plots.

TABLE 12C. COMPARISON OF GROUPS BY CONSTITUENTS. (AVERAGES, MOISTURE-FREE BASIS).

Plots	Calcium (CaO) 1925 Crop			Magnesium (MgO) 1925 Crop		
	Dark	Light	All	Dark	Light	All
	%	%	%	%	%	%
N1	5.85	6.83	6.19	0.98	0.99	0.99
N2	5.41	6.69	6.05	0.75	0.73	0.74
N3	5.76	6.70	6.23	0.78	0.79	0.79
N4	6.42	7.71	7.07	0.84	0.89	0.87
N5	6.42	7.57	7.00	0.81	0.78	0.80
N6	6.26	7.23	6.75	0.81	0.83	0.82
N7	6.14	7.23	6.69	0.99	0.93	0.96
Maximum	6.42	7.71	7.07	0.99	0.99	0.99
Minimum	5.41	6.69	6.05	0.75	0.73	0.74
Average	6.04	7.14	6.57	0.85	0.85	0.85

Although no special carriers of magnesia were used in the fertilizer mixtures applied to these plots, they received annually about 15 lbs. in cottonseed meal and castor pomace. Since there was no indication of "sand drown" on these plots during 1925 and 1926, we may conclude that this quantity is sufficient for the needs of the crop. Immediately adjacent to these plots are others where the effect of different quantities of fertilizer magnesia are being tested by Dr. W. W. Garner of the United States Department of Agriculture. He has kindly furnished the following magnesia analyses of 1925 tobacco from these plots:

Quantity of Magnesium (Lbs. MgO per acre) in fertilizer		Percent magnesium (MgO), in leaves
	W. W. G. PLOTS	
0		0.28
30		1.40
60		2.07
	OUR PLOTS	
15		0.85

These figures show that increases in fertilizer magnesia are reflected in the magnesia content of the leaves. The plots which received no magnesia had leaves showing typical sand drown.

Phosphoric acid, Potash and Chlorine. The results are summarized in Table 12d. The different fertilizer treatments received by the several plots are not reflected in any conspicuous degree by the phosphoric acid content of the leaves of the various plots. Dark leaves are slightly higher in phosphorus than the light leaves, which agrees with analyses from the adjacent phosphorus plots.[1]

[1] Conn. Exp. Sta., Tobacco Station Bull. 8, p. 14.

Considering the rôle of this element in protein synthesis its greater abundance in leaves nearest the growing point is to be expected.

TABLE 12d. COMPARISON OF GROUPS BY CONSTITUENTS. (AVERAGES, MOISTURE-FREE BASIS).

Plots	Phosphoric acid (P_2O_5) 1925 Crop			Potash (K_2O) 1925 Crop			Chlorine (Cl) 1925 Crop		
	Dark	Light	All	Dark	Light	All	Dark	Light	All
	%	%	%	%	%	%	%	%	%
N1	0.85	0.70	0.78	7.91	8.28	8.10	0.44	0.37	0.41
N2	0.75	0.69	0.72	7.24	8.63	7.94	0.51	0.46	0.49
N3	0.83	0.83	0.83	8.26	9.40	8.83	0.57	0.48	0.53
N4	0.87	0.75	0.81	7.85	8.15	8.00	0.46	0.34	0.40
N5	0.78	0.73	0.76	7.60	8.13	7.87	0.46	0.34	0.40
N6	0.68	0.62	0.65	7.52	8.54	8.03	0.60	0.57	0.59
N7	0.80	0.64	0.72	7.75	8.64	8.20	0.76	0.60	0.68
Maximum	0.87	0.83	0.83	8.26	9.40	8.83	0.76	0.60	0.68
Minimum	0.68	0.62	0.65	7.24	8.13	7.87	0.44	0.34	0.40
Average	0.79	0.71	0.75	7.73	8.54	8.13	0.54	0.45	0.50

Potash is consistently more abundant in the lower leaves, an observation in accord with Jenkins' results on the crop of 1896. Between plots the differences are not notable save for the fact that plot 3 shows the maximum both in dark and in light leaves.

Chlorine was a little higher in the dark leaves than in the light, but the quantity is also quite small and not very variable for the different plots. The highest percentage is in the N7, (tankage) plots, the next highest in the fish plots (N6). Both of these materials contain some chlorine. It is possible that the higher percentage of chlorine in N7 explains why the burn is not quite so good as for N1.

Sulphur. Determinations of this element are summarized in Table 12e. The quantity of sulphur which the several plots have received through fertilizer applications in the past five years has varied widely. The largest amounts of sulphur have been introduced through the applications of ammonium sulphate (60% SO_3), but dry ground fish (5% SO_3), acid phosphate (25% SO_3), and sulphate of potash (46% SO_3), have also added considerable amounts of sulphur.

TABLE 12e. COMPARISON OF GROUPS BY CONSTITUENTS.
(AVERAGES, MOISTURE-FREE BASIS).

Group	Total Sulphur (S)						Sulphur (S). in Ash			Ratio Sulphur in Ash to Total Sulphur	Sulphate Sulphur			Organic Sulphur (Total S–Sulph. S.)		
	1925 Crop			1926 Crop			1925 Crop			1925 Crop	1926 Crop			1926 Crop		
	Dark	Light	All	Dark	Second	All	Dark	Light	All	All	Dark	Second	All	Dark	Second	All
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
N1	0.75	0.68	0.72[1]	0.79	0.73	0.76	0.66	0.63	0.65[1]	0.90	0.75	0.66	0.71	0.04	0.07	0.05
N2	0.74	0.74	0.74[1]	0.84	0.66	0.75	....	....	0.69[2]	0.93	0.69	0.56	0.63	0.15	0.10	0.13
N3	0.84	0.84	0.84[1]	1.08	0.84	0.96	....	....	0.78[2]	0.93	0.96	0.79	0.88	0.12	0.05	0.08
N4	0.97	0.90	0.94[1]	1.04	0.89	0.96	....	....	0.85[2]	0.90	0.98	0.74	0.86	0.06	0.14	0.10
N5	0.79	0.81	0.80[1]	0.95	0.75	0.85	0.76	0.72	0.74[1]	0.93	0.80	0.62	0.71	0.15	0.13	0.14
N6	0.74	0.70	0.72[1]	0.87	0.76	0.82	....	....	0.67[2]	0.93	0.75	0.62	0.69	0.12	0.14	0.13
N7	0.75	0.70	0.73[1]	0.79	0.69	0.74	....	....	0.61[2]	0.84	0.67	0.55	0.61	0.12	0.14	0.13
Maximum	0.97	0.90	0.94	1.08	0.89	0.96	....	....	0.85	0.93	0.98	0.79	0.88	0.15	0.14	0.14
Minimum	0.74	0.68	0.72	0.79	0.66	0.74	....	....	0.61	0.84	0.67	0.55	0.61	0.04	0.05	0.05
Average	0.79	0.78	0.78	0.91	0.76	0.83	....	....	0.71	0.91	0.80	0.65	0.73	0.11	0.11	0.11

[1] Checked by analysis of a composite sample for the group.
[2] Determined on a composite sample for the group.

The following summary shows (1) the quantities of sulphur (as SO_3), applied to the several plots in the fertilizer, (2) the quantities of sulphur (as SO_3), found in the tobacco leaves of the 1925 crop, (3) the percentage of sulphate (SO_3), in the ash of the leaves, and (4) the average burn for the several plots.

TABLE 13. CORRELATION OF SULFUR IN FERTILIZERS AND IN TOBACCO CROP.

Plot	Pounds of SO_3 applied in fertilizer						SO_3 in ash of tobacco 1925	Pounds SO_3 per acre, in crop of 1925	Average burn, seconds. Crops of 1925 and 1926
	1922	1923	1924	1925	1926	total	%		
N1	226	226	226	76	76	830	1.63	33.29	35.4
N2	399	399	399	94	94	1385	1.73	34.75	29.4
N3	610	610	610	172	172	2071	1.95	39.32	20.9
N4	237	237	237	335	335	1381	2.13	42.97	15.0
N5	504	504	504	73	73	1661	1.85	39.41	17.5
N6	286	286	286	153	153	1164	1.68	35.32	25.9
N7	215	215	215	104	104	853	1.53	31.38	30.3

There appears to be an inverse correlation between the amount of sulphur applied to the soil and the burning capacity of the leaf produced thereon. The three plots which have been notable for poor burn (as well as poor quality) are N3, N4 and N5. These are the plots which have received the largest applications of sulphate in the fertilizer and which show the highest percentages of sulphate in the ash of the leaves. The plot which had the poorest burn (N4), received the heaviest application of sulphur in 1925 and 1926. Plots N3 and N5 also produced leaves of poor burning capacity. These plots received relatively light applications of sulphur in 1925 but heavy applications in the preceding years the effects of which were probably carried over. In general, it appears that substantial increases in applications of sulphate-containing fertilizers are followed by increased absorption of sulphur in the tobacco plant. This is in accord with the observations of Jenkins[1] in the Poquonock experiments of 1896; however, he found somewhat greater increases than are shown by the results recorded here. Patterson[2] also found increased absorption of sulphur by tobacco following increases of sulphur in fertilizer applications. In the Poquonock experiments, tobacco from the high sulphur plots was very poor in fire-holding capacity.

The evidence presented here is not conclusive proof that the increased sulphur content of the leaf is the cause of the poor burning quality observed, but the correlation suggests it as a probable cause or a contributing factor. The detrimental effects of chlorine are not conspicuous in the amounts shown by these analyses.

[1] Conn. Exp. Sta. Report. 1896.
[2] Agr. Sci.. 8. 329. 1894.

The sulphur retained in the ash constitutes about 90 per cent of the total sulphur and is nearly identical in amount with that obtained by extracting the leaf with dilute hydrochloric acid and which is designated as sulphate sulphur.

Nitrogen and **Nicotine.** The original purpose of this series of tobacco plots was to compare the effects of different nitrogenous fertilizers upon the composition and character of the tobaccos grown thereon as regards nitrogen distribution in the leaf. These analytical results are summarized in Table 12f.

TABLE 12f. COMPARISON OF GROUPS BY CONSTITUENTS.
(AVERAGES, MOISTURE-FREE BASIS).

Plot.	Total Nitrogen			"Ammonia" Nitrogen			Nitrate nitrogen			Nicotine, nitrogen, calc. from nicotine.			Nicotine		
	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All	Dark	Light	All
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
							1925	Crop							
N1	4.74	3.92	4.33	0.82	0.49	0.66	1.02	1.28	1.15	0.54	0.39	0.47	3.10	2.26	2.68
N2	4.54	3.88	4.21	1.00	0.51	0.76	0.93	1.30	1.11	0.52	0.39	0.46	3.01	2.23	2.62
N3	4.78	3.94	4.36	0.85	0.46	0.66	0.98	1.30	1.14	0.50	0.32	0.41	2.91	1.84	2.38
N4	4.87	4.05	4.46	0.90	0.53	0.72	1.01	1.33	1.17	0.53	0.39	0.46	3.08	2.28	2.68
N5	4.90	4.25	4.58	0.82	0.54	0.68	1.07	1.48	1.27	0.47	0.36	0.42	2.74	2.11	2.43
N6	4.70	3.91	4.30	0.82	0.50	0.66	1.07	1.36	1.22	0.52	0.36	0.44	3.04	2.12	2.58
N7	4.76	3.87	4.32	0.81	0.49	0.65	0.92	1.31	1.12	0.55	0.39	0.47	3.18	2.29	2.74
Maximum	4.90	4.25	4.58	1.00	0.54	0.76	1.07	1.48	1.27	0.55	0.39	0.47	3.18	2.29	2.74
Minimum	4.54	3.87	4.21	0.81	0.46	0.65	0.92	1.28	1.12	0.47	0.32	0.42	2.74	1.84	2.38
Average	4.76	3.97	4.36	0.86	0.50	0.68	1.00	1.34	1.17	0.52	0.37	0.45	3.01	2.16	2.59
							1926	Crop [1]							
N1	5.56	4.49	5.03	1.35	0.75	1.00	1.11	1.26	1.19	...	...	...	...	...	...
N2	5.57	4.12	4.85	1.26	0.58	0.92	1.03	1.27	1.15	...	...	...	...	...	...
N3	5.74	4.14	4.94	1.37	0.55	0.96	0.93	1.15	1.03	...	...	...	...	...	...
N4	5.59	4.44	5.01	1.26	0.61	0.94	0.94	1.19	1.06	...	...	...	...	...	...
N5	5.68	4.39	5.04	1.16	0.57	0.87	1.18	1.41	1.30	...	...	...	...	...	...
N6	5.58	4.38	4.98	1.20	0.54	0.87	1.20	1.34	1.27	...	...	...	...	...	...
N7	5.70	4.13	4.92	1.19	0.58	0.92	1.13	1.23	1.18	...	...	...	...	...	...
Maximum	5.74	4.49	5.04	1.37	0.75	1.00	1.20	1.41	1.30	...	...	...	...	...	...
Minimum	5.56	4.12	4.85	1.16	0.54	0.87	0.93	1.15	1.03	...	...	...	...	...	...
Average	5.63	4.30	4.91	1.24	0.60	0.93	1.07	1.26	1.17	0.64	0.40	0.52	3.70	2.34	3.02

[1] Seconds used instead of light in 1926 series.

It will be noted that total nitrogen is invariably higher in the dark leaves than in the light leaves or in the seconds. This might be expected since the dark leaves are nearer the growing point where the protein content of the cells is highest in all plants. It would be expected also that nicotine would be most abundant in the upper leaves and the results show that such is the case. The same is true for the alkaloidal content of the leaves of other species of plants, tea for example, the old leaves of which are practically devoid of caffeine.

That nitrate nitrogen is more abundant in the lower leaves is shown by the results obtained on the crops of both years. Jenkins[1] found somewhat more nitrates in the long wrapper (upper) leaves as reported in 1896 but the reverse was true according to certain results reported earlier.[2] Total nitrogen is higher in the 1926 crop but nitrate nitrogen is about the same for both years.

The partition of nitrogen evaluated as "ammonia" nitrogen must be interpreted with the reservations already mentioned in the discussion of methods. It will be noted that this value parallels the nicotine content with respect both as to the distribution between dark and light leaves and as to the increases observed in the 1926 crop. While there is no doubt that nicotine enhances the "ammonia" value there is still evidence of ammonia in considerable amounts. Young[3] however, concludes that the tobaccos which he examined contained little, if any, ammonia.

Comparing the individual plots there seem to be no significant quantitative differences. We may conclude from this that none of the nitrogenous fertilizers used had any marked differential influence on the quantity of nitrogen absorbed by the plants. When 200 pounds of ammonia per acre are applied, whether it be in the form of cottonseed meal, castor pomace, nitrate of soda, sulphate of ammonia, fish or of tankage, substantially the same amount of nitrogen is found in the leaf.

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[1] Conn. Exp. Sta. Report 1896. p. 326.
[2] Conn. Exp. Sta. Report 1892, p. 29.
[3] Analyst. 52, 15. 1927.

Tobacco in 1896 and in 1925

A comparison of the experimental crop of tobacco in 1896 with the crop of 1925 on the basis of constituents in the moisture-free crude ash is given in the following summary:

Table 14. Composition of Tobacco Crop of 1925 Compared With That of 18(

	1896 Long Wrapper		1896 Short Wrapper		1925	
	range	avg.	range	avg.	range	a
and and SiO_2	7.5—12.9	11.0	18.0—27.0	23.4	4.3— 5.7	4
on and Al.	0.8— 1.4	1.1	1.1— 1.7	1.4	0.7— 1.0	C
ime, CaO	14.5—25.1	20.1	10.0—22.0	17.6	22.7—27.3	25
lagnesia, MgO	2.3—11.0[1]	6.8[2]	2.5—12.3[5]	6.6[6]	2.9— 3.7	:
otash, K_2O	24.9—35.7	29.7	20.0—30.0	24.1	30.1—32.1	31
$_2O_5$	2.0— 3.1	2.2	1.1— 2.1	1.6	2.5— 3.1	:
O_3	2.5— 7.7[3]	4.1	1.4— 6.6[7]	3.0	3.5— 4.8	4
l	0.4— 8.5[4]	1.7	0.3— 5.9[8]	1.0	1.3— 2.6	1

[1] Omitting one result, 2.3—8.9
[2] " " " average is 6.3
[3] " " " 2.5—6.0
[4] " " " 0.4—1.5
[5] " " " 2.5—8.9
[6] " " " average is 6.0
[7] " " " 1.4—4.7
[8] " " " 0.3—0.7

It appears that certain constituents varied more widely in the 1896 crop than in the recent one. The higher content of sand and silica simply means that the leaves in that year were not so free from adhering dirt. The sum of the calcium and magnesium is substantially the same in both years and there are no conspicuous differences in other items so far as shown in the above comparison. There seems to be no basis for the opinion, not infrequently held by growers, that the tobacco plant today is absorbing from the soil a ration of nutrients which is radically different from that of 30 years ago.

Summary

Comparing the effects of fertilizer formulas in which cottonseed meal, castor pomace, nitrate of soda, sulfate of ammonia, dry ground fish and tankage were used in the combinations previously described, we find that:

1. Different sources of fertilizer nitrogen have not substantially affected the quantity of total nitrogen, "ammonia" nitrogen, nitrate nitrogen or nicotine in the leaf, nor the ratios between them.

2. The percentages of total nitrogen, of "ammonia" nitrogen and of nicotine are invariably higher in the upper than in the lower leaves. Nitrate is more abundant in the lower leaves.

3. The different fertilizer treatments have not affected appreciably the percentages of total ash, soluble silica, iron, calcium, magnesium, phosphorous or potash in the leaf.

4. Increased percentages of manganese, sulfur, and, to a less degree, alumina in the leaves were found in those plots treated with sulfate of ammonia. This is correlated with a more acid soil reaction and a poorer burn of the tobacco.

5. The lower leaves of the plants (seconds and lights) have higher percentages of total (crude) ash, potash and calcium than the upper leaves.

6. The upper leaves (darks) have higher percentages of phosphorus, nitrogen, and chlorine than the lower leaves.

THE EFFECT OF SOME NITROGENOUS FERTILIZERS ON SOIL REACTION

M. F. Morgan and P. J. Anderson

Considerable attention has been focused during recent years on the importance of keeping a proper degree of soil acidity for the growing of tobacco. Some soils are so acid that the growth is stunted, others are not acid enough and consequently the crop suffers from rootrot.

It is common knowledge that lime and wood-ashes are the principle agents responsible for neutralizing the acidity of the soil and thus bringing about a condition favorable to rootrot. Concerning the effect of the other materials which are applied so generously and continuously to tobacco fields as fertilizers, there is little information at hand. Since the long continued use of a certain material, by changing reaction always in one direction, may have a potent influence for good or evil, it would be desirable to ascertain the tendency of each of our common fertilizer ingredients.

The fertilizer experiments which are in progress on the tobacco station farm offer an excellent opportunity for determining some of these effects. Each plot is treated annually with the same fertilizer throughout a period of years. Soil samples are taken periodically, tested, and kept on file for future study. Location of plots is the same from year to year.

The present discussion will be confined to the nitrogen ingredients, reserving the others for future reports. Our most extensive field experiment on nitrogen sources is the series of 21 plots on Field I known in our previous reports as the "Old Nitrogen Series". This experiment was conducted for five years, 1922-26, and the results fully reported in Tobacco Station Bulletins 5, 7, and 8. No mention of soil reaction, however, was made in these previous reports.

The plots were in triplicate and different nitrogen carriers were used on the different plots but the actual amount of nitrogen, phosphoric acid and potash applied annually was the same on each during the five years. No soil samples were taken when the experiment was begun in 1922 but since the land is fairly uniform and previous treatment had been the same, it is safe to assume that the reaction of all plots was approximately the same originally. The first set of soil samples was taken in May, 1925, the second set in May, 1927. All samples were taken before plowing in spring. All determinations were by potentiometer. The treatment of these 21 plots is described in Bulletins 5 and 6 of the Tobacco Station. The results of the tests are presented in Table 15.

Table 15. Old Nitrogen Series On Field I.
Carriers of nitrogen and reaction
of soils in 1925 and 1927.

Plot No.	Lbs. of ammonia carrier 1922–24	Reaction May 1925	Lbs. of ammonia carrier 1925–26	Rea M 19
N1	2100 C. S. Meal	4.73	1463 C. S. Meal	4.
N1*	800 Cast. Pomace	4.60	588 Cast. Pomace	4.
N1**	200 Nitr. Soda	4.66	212 Nitr. Soda	4.
Ave.		4.66		4.
N2	1270 C. S. Meal	4.63	915 C. S. Meal	4.
N2*	410 Cast. Pomace.	4.55	368 Cast. Pomace	4.
N2**	365 Nitr. Soda	4.58	531 Nitr. Soda	4.
	260 Sulf. Am.			
Ave.		4.59		4.
N3	550 Sulf. Am.	4.54	1463 C. S. Meal	4.
N3*	676 Nitr. Soda	4.46	588 Cast. Pomace	4.
N3**		4.53	160 Sulf. Am.	4.
Ave.		4.51		4.
N4	1270 C. S. Meal	4.55	915 C. S. Meal	4.
N4*	410 Cast. Pomace	4.55	367 Cast. Pomace	4.
N4**	265 Sulf. Am.	4.57	400 Sulf. Am.	4.
	435 Nitr. Soda			
Ave.		4.56		4.
N5	724 Sulf. Am.	4.20	1829 C. S. Meal	4.
N5*	552 Nitr. Potash	4.26	735 Cast Pomace	4.
N5**		4.35		4.
Ave.		4.27		4.
N6	1150 C. S. Meal	4.40	731 C. S. Meal	4.
N6*	1250 H. G. Fish	4.33	294 Cast. Pomace	4.
N6**	200 Nitr. Soda	4.57	958 H. G. Fish	4.
			106 Nitr. Soda	
Ave.		4.50		4.
N7	1150 C. S. Meal	4.46	731 C. S. Meal	4.
N7*	1359 Tankage	4.47	294 Cast. Pomace	4.
N7**	200 Nitr. Soda	4.40	769 Tankage	4.
			80 Nitr. Soda	
Ave.		4.44		4.

These tests furnish data from which we can judge the effect of the following sources of nitrogen:

1. Sulfate of ammonia.
2. Nitrate of soda.
3. A 3 to 1 combination of cottonseed meal and castor pomace.
4. Dry ground fish.
5. Tankage.

The evidence on each of these may be discussed separately:

Sulfate of ammonia. The N5 plots received the heaviest sulfate of ammonia application of any of the plots during the first three years. At the end of that time they were the most acid of all the plots. During the last two years the N4 plots were the ones to which the heavy dose of sulfate was applied. Correspondingly, they were the most acid at the end of the two years. Even 160 lbs. of sulfate on the N3 plots caused a decided drop in reaction when it was not counterbalanced by nitrate of soda during the last two years. The acidifying tendency of sulfate of ammonia can be traced on every plot where it was used.

Nitrate of soda. The effect of this material is best observed on the N2 plots. These plots were more acid than the N1 plots at the end of the first three years but during the last two years they received heavy applications of nitrate of soda without any counterbalancing sulfate of ammonia. As a result, the raction at the end of five years was the least acid of any of the plots. This same influence of nitrate of soda may be observed also, but to a less degree, on the other plots where smaller quantities of it were used.

Combination of cottonseed meal and castor pomace. This seems to have no appreciable effect on the reaction of the soil as may be seen during the last two years of the N5 plots.

Fish. Comparing the N1 plots with the N5 plots there seems to have been a slight acidifying tendency from the use of fish. This is mild as compared with the effect of sulfate of ammonia.

Tankage seems to have had the same tendency as fish but the results are not very conclusive. The changes in reaction both from fish and from tankage have been too small to warrant a conclusion that they have any *pronounced* tendency to change the soil reaction.

Further data on the effect of some nitrogenous substances on the reaction of the soil were furnished by the set of experiments described on page 60 in which four different nitrogen carriers were compared when each was used as the *only* source of nitrogen. These were *cottonseed meal, nitrate of soda, sulfate of ammonia* and *urea.* This experiment was started in 1926 on uniform soil. The soil was tested one year later and again in December, 1927. The reactions determined are presented below:

Table 16. Soil Reactions (pH) on Single Source of Nitrogen Plots

Carrier	Reaction	
	May 3, 1927	December 1, 1927
Cottonseed meal	5.21	5.85
Nitrate of Soda	5.42	6.12
Sulfate of Ammonia	4.99	5.35
Urea	5.03	5.58

The fact that all reactions are higher in December than in May is due to seasonal variation. It will be noted that at each test the nitrate of soda plot had the highest reaction and the sulfate of ammonia had the lowest. This corroborates our conclusion from the old nitrogen series that nitrate of soda makes the land less acid and sulfate of ammonia makes it more acid. There is no indication that cottonseed meal has any effect on the reaction.

Urea seems to have made the soil somewhat more acid.

In other experiments at New Haven, urea was used as the source of nitrogen in combination with other treatments. During the first month after application these soils showed a noticeable tendency toward decreasing the acidity, probably due to the rapid formation of ammonia. After this period, and throughout the season, plots treated with urea were consistently about .2 pH more acid than corresponding plots without urea in all cases where no lime was used. This was on a soil having a reaction of 4.9 pH prior to treatment. The only explanation for this phenomenon that occurs to us is the theory that in the nitrification of the ammonia formed from the urea, there is a removal of basic material from the soil.

Summary

1. Sulfate of ammonia has had the strongest influence in changing the soil reaction. It has consistently made the soil more acid.

2. Nitrate of soda has just as consistently made it less acid but its influence in this direction is not quite so marked as the influence of sulfate toward acidity.

3. Cottonseed meal has not made any appreciable change in reaction.

4. Dry ground fish and tankage have had a very slight tendency to make the soil more acid.

5. Urea produces a slightly more acid condition after the initial period of rapid ammonia formation is concluded.

These results are in accord with those of experiments at other stations. The investigations by Hartwell and others at the Rhode Island station are particularly illuminating. These have been

fully discussed by Burgess.[1] His findings not only confirm ours on sulfate of ammonia, nitrate of soda, fish and tankage but he also adds results on two other sources of nitrogen which are sometimes used in tobacco mixtures, *viz.*, hoof meal and horn meal. These also seem to have a slight acid tendency like tankage and fish.

Two other mineral sources of ammonia which are coming to be used more frequently in tobacco mixtures are *nitrate of potash* and *nitrate of lime*. We have had only one year's experience with nitrate of lime. When the soil was tested and compared with the check plots at the end of the year, there was no appreciable difference. Plots which have been treated with nitrate of potash for three years at the rate of 267 lbs. per acre (43% K_2O) show no significant change in reaction during that time.[2]

SYNTHETIC UREA AS A SOURCE OF NITROGEN

The purpose of this experiment was to see whether synthetic urea can be used to replace, partly or entirely, the organic ammoniates in the fertilizer mixture.[3] During the third year, the six plots were in the same place on Field IX and the fertilizer mixture was identical with that applied during the preceding years except that the quantity of magnesia in all mixtures was equalized by use of magnesium carbonate in place of double sulfate of potash-magnesia which was previously used. This change was made in order to eliminate differences in sulfur content of the three formulas.

The two N1 plots had all the nitrogen in cottonseed meal, castor pomace and nitrate of soda. Standard formula, *no urea*.

On the N8 plots, *one-half* of the nitrogen was from urea, with the other half from cottonseed meal and castor pomace.

On the N9 plots, *all* of the nitrogen was supplied in urea.

The fertilizer was applied on May 20 and the field set to Havana Seed plants on May 28.

During the growing season, no differences in growth as between the various treatments were observed. There was still a poor spot in the center of the field as mentioned in reports of previous years[4] but this affected several of the plots and apparently had no relation to fertilizer treatment. The plants from this area were excluded

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[1] Bulletin 189, Rh. Island Exp. Station, 1922.

[2] After this bulletin had gone to press the very recent work of Pierre (Jour. Am. Soc. Agron. **20**: 254) came to our attention. His investigations substantiate the results herein reported, and his paper attempts detailed theoretical explanations of the changes in soil reaction produced by various nitrogenous fertilizers.

[3] Tobacco Station Bul. 8, p. 33 for a complete discussion of this experiment during the first two years.

[4] Tobacco Bul. 6, p. 14.

at harvesting. On account of the unfavorable season the crop was light. All plots were harvested on August 5 and sorted in the station sorting shop in December. During the sorting it was noted that the tobacco from the three south plots was somewhat dead and yellow and therefore contained a considerable percentage of "brokes" as indicated in Table 17. The three north replicates, however, produced tobacco of good quality. This difference between the south three and the north three plots has been apparent throughout the three years of this experiment as may be seen by reference to yields in Table 18. The differences have been consistently about 200 lbs. per acre in favor of the north tier of plots. This inequality is apparently due to soil differences in the field and bears no relation to fertilizer treatment.

The yields, sorting records and grade indices* for 1927 are presented in Table 17. A summary of the three years' experiment is shown in Table 18.

The latter table shows that the average yield during the three years is so nearly the same (less than half of 1% difference) that the differences are not significant. The grade index for the standard formula and for the ½ urea formula is also practically the same but there is a drop of about .02 when urea was the only source of nitrogen.

These results strengthen the tentative opinion stated in our report for 1926 that urea may be advantageously used to furnish a part, probably up to one-half, of the nitrogen of the fertilizer formula.

Further experiments in which urea was used as the only source of nitrogen are discussed on p. 60.

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* *The Grade Index.* In comparing the quality of tobacco grown on different plots it is very difficult to keep in mind the percentage of six to eight commercial grades of tobacco from one plot and compare with a like number from another. To simplify these comparisons a grade index was devised. The grade index is a single number expressing the quality of *all* the tobacco grown on a particular plot. It is based on the percentage of carefully assorted commercial grades and the relative price value of the different grades. Although market prices vary from year to year, it was found after consultation with experienced dealers, that the ratios of prices between the different grades are fairly constant. These adopted price relationships for the different grades are as follows:

(L)	Light wrappers	1.00	(LD)	Long darks (19" up)	.30
(M)	Medium wrappers	.60	(DS)	Dark stemming (17")	.20
(LS)	Long sec. (19" up)	.60	(F)	Fillers	.10
(SS)	Short seconds (15" and 17")	.30	(Br)	Brokes	.10

The grade index of any plot is obtained by multiplying the percentage of each grade by the price in the above schedule and adding the products.

TABLE 17. UREA SERIES. YIELDS AND GRADINGS FOR CROP OF 1927.

ot o.	Nitrogen Treatment	Acre Yield		Percentage of Grades								Grade Index	
		Plot	Ave.	L	M	LS	SS	LD	DS	F	Br	Plot	Av
	No urea	1060	....	3	4	21	6	33	7	11	15	.337	...
		1296	1178	9	10	17	9	34	9	10	2	.411	.37 ...
	½ N from urea	1053	....	5	4	21	8	27	14	11	10	.354	
		1441	1247	11	19	13	7	37	2	7	4	.446	.40
	All N from urea	1060	....	3	5	14	6	35	8	4	25	.312	
		1223	1142	12	12	14	8	32	10	9	3	.428	.37

TABLE 18. UREA SERIES. YIELDS AND GRADE INDICES FOR THREE YEARS.

ot o.	Nitrogen Treatment	Yield per acre				Grade Index			
		1925	1926	1927	Ave of 6	1925	1926	1927	Ave of 6
	No urea	1364	1501	1060	....	.268	492	.337	....
		1561	1711	1296	1416	.411	473	.411	.399 ....
	½N in urea	1356	1488	1053	....	.325	.545	.354	....
		1597	1695	1441	1422	.303	.405	.446	.396 ....
	All N in urea	1347	1622	1060	....	.257	.489	.312	....
		1465	1810	1223	1421	.352	.445	.428	.381 ....

FRACTIONAL APPLICATION SERIES

Many growers believe that they obtain better results by broadcasting only a part of the fertilizer mixture before setting and applying the remainder as a side dressing to the growing plants. The side dressing may also be divided and applied at two or three times. The usual time is just before hoeing in order to get the fertilizer well distributed about the plants. There is great diversity of opinion among growers as to the benefits of such a practice and in regard to time of making later applications and as regards materials to be used. Some use the same mixture for both broadcasting and side dressing. More often, however, only the quickly available nitrogen carriers are used for the side dressings. This

practice is based on the assumption that nitrogen which is applied early may leach away and the plants will suffer from shortage unless some quickly available form is applied later. The potash and phosphorus on the other hand do not leach appreciably.

Field tests were begun at the experiment station in 1923 to compare these two methods. From the results of the experiment of the first three years, described in Bulletins 5 and 6, it was concluded that nothing was gained either in yield or quality by fractional application. In those experiments, however, the mixture applied at each time was of the same composition. Beginning with 1926 a new series was started which differed from the first series in two ways: (1) the six plots were located on extremely leachy soil and (2) only the nitrogen carriers were reserved for side dressings. The composition of the fertilizer for each application was as follows:

Carrier	Pounds per acre			
	Broadcast before setting	1st side dressing	2nd side dressing	Total
C. S. Meal	463.4	600	400	1463.4
Cast. Pomace	1323.5	...	...	1323.5
Nitr. Soda	35.5	35	35	105.5
Ammo. Phos	33.1	35	35	103.1
Ppt. bone	185.4	...	...	185.4
Sulf. potash	164.8	...	...	164.8
Carb. potash	126.8	...	...	126.8

This formula supplies 250 lbs. ammonia, 160 lbs. phosphoric acid and 200 lbs. potash. The three fractional plots were on different parts of the field but each was immediately adjacent to a check plot where the same mixture was used but all at one time as a broadcast application.

The season of 1926 was very dry. No differences in growth as between the two fertilizer methods were observed. The yield records of these plots are included in Table 19. The season of 1927 was just the opposite, being very wet and theoretically should have been very favorably for the fractional plots.

The broadcast application of fertilizers in 1927 was made on May 20. The field was set on June 7. The stand was uniform and the growth was good throughout the season but no marked differences resulting between the two methods of fertilizing were observed in the field.

The second application of fertilizer was made on June 20 and the third on June 30.

All plots were harvested on August 11; thus the tobacco was in the field just 64 days. It was stripped in September and sorted in station shop in December.

TABLE 19. FRACTIONAL APPLICATION SERIES, 1926 AND 1927.

	Treatment	Yield per acre 1927	Yield per acre 1926	Percentage of grades, 1927 L	M	LS	SS	LD	DS	F	B	Grade Index 1927
	Fractional	1148	1300	9	6	15	11	29	9	17	4	.375
	Broadcast	1221	1426	11	8	18	14	27	8	11	3	.419
·I	Fractional	1211	1550	15	7	15	10	33	2	13	5	.433
-I	Broadcast	1291	1612	20	15	9	10	29	3	11	3	.481
	Fractional	1413	1603	21	16	9	6	33	2	10	3	.494
	Broadcast	1343	1618	13	11	15	9	34	2	12	4	.435
of fractional		1257	1484	15	10	13	9	32	4	13	4	.434
of broadcast		1288	1552	14	11	14	11	30	4	11	3	.445

The sorting and yield records are presented in Table 19. In ɜach case the fractional plot is compared with broadcast plot imnediately adjacent.

These data show that the tobacco on the fractional plot had a ıigher yield or better grading record only in one of the three com)arisons. The averages in both methods of measuring are some-what adverse to fractional applications.

Yield records for the dry year 1926 are included in the above able. They show the same adverse effect of fractional application. Quality records were not made for 1926.

These results are in accord with those from our previous tests, n that they show no advantage to be gained by making several ıpplications as compared with a single original application of the ;ame quantity and kind of fertilizer.

In 1927 another series of fractional application plots was started n which nitrate of lime was used as the only source of nitrogen n comparison with a single broadcast application of castor pomace. The broadcast mixtures were spread on the plots on May 21 and he fractionals were made June 15 and July 8. The schedule of ertilizer applications are given in Table 20.

BLE 20. GIVING DATE OF APPLYING FERTILIZERS IN FRACTIONAL NITRATE OF LIME PLOTS. TOBACCO SET, MAY 26, 1927.

Source of Ammonia	Broadcast applications (May 21) NH_3	P_2O_5	K_2O	Fractional Applications Ammonia June 15	July 8	Total NH_3
None	0	80	200	0	0	0
Nitrate of lime	9	80	200	18	36	63
Nitrate of lime	18	80	200	36	72	126
Nitrate of lime	36	80	200	72	108	216
Nitrate of lime	72	80	200	144	...	216
Castor pomace	216	80	200	none	none	216

Observable differences in effects of these treatments on the growth and appearance of the tobacco were apparent as early as the middle of June. Symptoms of yellowing and smaller growth were found on all of the nitrate of lime plots. In contrast, the tobacco grown on the castor pomace plot was larger and of a deeper healthier green color. On June 25 the noticable differences between the nitrate of lime plots were more of size than color. The size of the plants was almost in proportion to the amount of ammonia applied. This condition prevailed until harvest on August 7.

The effects of these treatments on the yield and quality are given in Table 21.

TABLE 21. SORTING RECORDS, YIELDS, AND GRADE INDEX OF FRACTIONAL APPLICATIONS OF NITRATE OF LIME *Versus* A SINGLE BROADCAST APPLICATION OF CASTOR POMACE, 1927.

Plot No.	Lbs. NH_3 per acre.	Percentage of grades				Grade index	Yield per acre
		D	S	B	F		
N19	0	7	3	29	61	.112	602
N20	63	30	27	22	21	.228	827
N21	126	32	31	22	15	.250	1028
N22	216	33	32	19	16	.295	1102
N23	216	35	35	14	16	.316	1125
N24	216	32	40	14	14	.328	1135

These results indicate a serious decrease in yield and quality when the total ammonia applied per acre is reduced below 126 pounds. Considerably better quality and yield were obtained when this was raised to 216 pounds. Similar results may be anticipated the first year, particularly if the rainfall of the season is above normal. The low yields due to nitrogen deficiency in the soil also are correlated with poor quality.

Where high yields are desired there seems to be no evidence in favor of fractional application. These results also support the general idea that to most crops nitrogen should be applied early, although there was no serious falling off in quality by a late, heavy application (July 8) on plot N22 as compared with N23.

SINGLE SOURCES OF NITROGEN

An experiment to determine the effect of single sources of nitrogen was begun on four plots in 1926. Nutrients were supplied to all at the rate of approximately 200 lbs. ammonia, 160 lbs. phosphoric acid and 200 lbs. potash per acre, the only difference in the four plots being in the carrier of nitrogen. The materials compared were nitrate of soda, sulfate of ammonia, urea and cotton-

seed meal. In 1927, castor pomace and nitrate of lime plots were added to the test. All of these plots were located on fairly light leachy soils.

No striking differences in field growth were noted in the dry season of 1926, except that the nitrate of soda plot seemed much better than the cottonseed meal plot. In 1927, an exceptionally wet season, certain abnormal symptoms of growth on the nitrate of soda plot were evident three or four weeks after transplanting. These symptoms were yellowing due to insufficient nitrogen and also a chlorotic condition diagnosed as magnesia hunger. As the season progressed, nitrogen deficiency apparently was the limiting factor causing yellow stunted growth, and masking the magnesia hunger symptoms. At harvest, magnesia hunger was very severe on the sulfate of ammonia plot. The cottonseed and castor pomace plots had no magnesium chlorosis and the urea plot had only a slight amount on a small percentage of the plants. These three plots (cottonseed meal, castor pomace, urea) maintained a healthy green color throughout the season.

The tobacco grown on sulfate of ammonia apparently had sufficient nitrogen (as indicated by yields) and had a dark green color on all the leaves not affected by magnesium chlorosis. The reason for the severity of this trouble on this plot in contrast to the urea plot is difficult to explain. There is a possibility of the soluble magnesia in the soil combining with the sulfate radical in excess and forming magnesium sulfate, a highly soluble salt, which later was leached from the surface soil by the heavy rains. The urea, however, did not supply any sulfate to cause this effect. Enough magnesia was supplied in cottonseed meal or castor pomace to fulfill the requirements of the plant, and chlorosis did not occur on these plots. It seems, therefore, that the response of a plant to particular nitrogenous fertilizers may depend largely on the seasonal factors of rainfall and temperature.

The sorting records of these plots are given in Table 22.

TABLE 22. SORTING RECORDS OF TOBACCO GROWN ON SINGLE SOURCES OF NITROGEN.

1926–1927

Material	Percentage of Grades											
	D		S		L		M		F		B	
	1926	1927	1926	1927	1926	1927	1926	1927	1926	1927	1926	192
C.S. Meal	45	40	24	33	5	0	2	0	20	13	4	14
Nitr. Soda	47	20	26	5	6	0	4	0	16	55	1	20
Sulf. Amm.	50	35	29	42	5	0	3	0	10	11	3	12
Urea	46	40	26	33	7	3	4	5	14	13	3	14
Nitr. Lime	..	33	..	32	..	0	..	0	..	16	..	19
Nitr. Lime	..	35	..	45	..	0	..	0	..	16	..	14
Cast. pom.	..	32	..	40	..	0	..	0	..	14	..	14

The sorting records indicated that good quality tobacco was produced by cottonseed meal and castor pomace. Nitrate of soda had a tendency to produce harsh, dry, non-elastic, yellow tobacco. Tobacco grown on urea was of fair to good quality, while sulfate of ammonia produced coarse, veiny (white and prominent veins), dark, heavy tobacco in all grades. The *yield* was highly satisfactory when sulfate of ammonia was the nitrogen source. It gave the highest yields of the substances tried. Nitrate of lime was much more satisfactory than nitrate of soda, but it must be remembered that this has been tried only for one year.

A summary of the results of these trials is given in Table 23.

TABLE 23. SUMMARY TABLE OF YIELDS AND GRADE INDEX. 1926–1927.

Plot No.	Material	Yield per acre			Grade Index		
		1926	1927	Ave.	1926	1927	Ave.
N11	C. S. Meal	1228	1131	1179	.288	.297	.292
N12	Nitr. Soda	1440	688	1064	.353	.130	.241
N13	Sulf. Amm.	1482	1386	1432	.370	.333	.351
N14	Urea	1350	1166	1258	.375	.350	.362
N22	Nitr. Lime	....	1102	....	....	.295	....
N23	Nitr. Lime	....	1125	....	....	.316	....
N24	Castor pomace	....	1135	....	....	.328	....

MANURE AS A SUPPLEMENT TO COMMERCIAL FERTILIZER

In the early days of tobacco growing in New England, manure was the only fertilizer used. It produced large yields of excellent[1] quality tobacco for many years previous to the advent of commercial fertilizers. When the farmers began to expand the acreage, there was not enough manure to adequately cover the land. This condition lead to the importation of manure from New York and other large cities, a practice which is still continued to some extent, but the diminishing supply and increasing cost are rapidly bringing this era to a close. From the day when commercial fertilizers began to supplant manure there has been a continuous controversy as to the relative merits of the two. It is now generally agreed that it is impracticable, in this section, to grow tobacco on manure *alone* but there is no unanimity on the question of whether it is best to use commercial fertilizer *alone* or to supplement it with manure. A half century or argument by growers, packers, and manufacturers, pro and con, supported by thousands

[1] Standards of quality in cigar leaf tobacco have probably changed, so what is remembered as "excellent" might not be accepted as such today.

of individuals' examples has not settled the dispute. When on the other hand, we turn to controlled experimental data from the Agricultural stations we find the results just as inconclusive. Thirty years ago Goessman[1] in Massachusetts and Jenkins[2] in Connecticut carried on manure experiments for several years but both hesitated to draw any conclusions from the data collected. More recently Jones[3] in Massachusetts started a more comprehensive experiment with manure. His results up to the present indicate some benefits from the addition of manure. No other manure experiments on New England tobacco have been published. It is surprising that there have been no more scientific attempts to solve so old and so important a question in tobacco growing, although the complexity of the problem is recognized.

To be sure, the problem is becoming of less importance because the supply of purchasable manure may become so scarce and costly within the next decade or two that none will be purchased. Nevertheless there will always be a limited supply produced on tobacco farms and the question to be decided is whether this could be used most advantageously to supplement the commercial fertilizer on the tobacco lot or whether it could be better used for other crops.

In an effort to determine more accurately the supplementary value of manure, the following experiment was begun in the fall of 1925 and two years' results are now available. It is planned to continue this experiment for a minimum period of five years. Since manure is known to have a long-continued after effect, it is too early to draw conclusions. The data of the first two years must be considered as merely indicative. Annual or biennial reports on this experiment will be published as data are available.

It is the common belief of tobacco growers that the benefits of manure are more pronounced on sandy, "leachy" land where it functions in retaining moisture and plant food. In conformity with this belief, a coarse sandy knoll was selected for the experiment. The crop has always been light on this field because it suffered from lack of water during dry years and the nitrogen leached away during rainy years.

Eight 1/20th acre plots are included in the experiment, four of which are treated annually with manure. Each manure plot has an adjacent plot which is not covered with manure but in every

[1] Goessman, C. A. Field experiments with tobacco in Massachusetts. Mass. Agr. Exp. Sta. Rpt. 10 (1898): 128-132. 1899.

[2] Jenkins, E. H. Experiments in growing tobacco with different fertilizer. Conn. Agr. Exp. Sta. Rpt. 20 (1896): 302-321. 1897.

[3] Jones, J. P. Report of progress in tobacco investigations. Mass. Agr. Exp. Sta. Circular 74: 4 1927.

other way is treated just like it. Two of the manure plots receive stable manure, the other two receive artificial, or so-called "Adco" manure.[1]

The stable manure is spread on the land during the fall and remains on top of the ground until the following spring when it is plowed under. Twenty loads per acre are applied to one of the plots and forty loads to the other. The adco manure is applied in the spring at the rate of some thirty loads per acre.

The following fertilizer mixture was applied alike to *all* plots from 10 days to two weeks before setting.

Carrier	Lbs. per acre	Nutrients per acre		
		NH_3	P_2O_5	K_2O
C. S. Meal	1463.4	120.00	42.40	21.95
Cast. Pomace	1323.5	90.00	23.80	13.24
Nitr. Soda	105.5	19.83	....	....
Ammophos	103.1	20.17	22.41	....
Ppt. Bone	185.4	....	71.39	....
Sulf. Potash	164.8	....	...	82.41
Carb. Potash	126.8	....	....	82.40
Total...............	3472.5	250.00	160.00	200.00

Although the same amount of plant food was applied in 1927, the composition of the mixture was altered slightly as follows:

Carrier	Lbs. per acre	NH_3	P_2O_5	K_2O
C. S. Meal	1463.4	120.00	42.40	21.95
Cast. Pomace	1323.5	90.00	23.80	13.24
Nitrate of Lime	105.5	19.83	....	....
Urea	36	20.17	....	....
Sulf. Potash	164.8	....	....	82.41
Carb. Potash	126.8	....	....	82.40
Total...............	3220.0	250.00	66.20	200.00

[1] *Preparation of Adco manure.* This is made in our case from grass and weeds by treating them with Adco reagent. After the grass was cut and partially dried, a stack was begun by making a layer about one foot high after tramping and watering until thoroughly saturated. A layer of the dry reagent was then spread over the top, then another layer of grass made in the same way as above and covered with the reagent. This was continued until there were six layers. Somewhat over a ton of grass and 150 lbs. of the reagent were used. The stack developed considerable heat at first and had to be watered frequently and turned several times. Other organic materials such as leaves, straw, corn stalks, etc., could be used but were not available for this experiment. The stacks were made in July but were not spread on the plots until the following spring, at which time they had the appearance and consistency of a rotted manure pile.

During 1926 no differences in growth were observed in the field. The season was very dry, resulting in small growth and poor quality on all of this part of the field.

The yield and sorting data for the eight plots are recorded in Table 24.

TABLE 24. MANURE PLOTS, 1926.

Plot No.	Treatment	Yield per A.	Percentage of grades								Grade index
			L	M	LS	SS	LD	DS	F	B	
:	40 loads stable manure per A	1404	7	6	6	17	35	14	13	2	.338
	No manure	1279	8	2	1	17	25	24	19	4	.295
-1	20 loads stable manure per A.	1489	8	10	15	12	35	5	12	3	.396
-1	No manure	1618	8	10	12	8	39	3	12	8	.379
:	Adco manure	1379	8	6	6	13	23	24	17	3	.328
4	No manure	1285	4	3	12	15	26	12	16	12	.305
:-1	Adco manure	1281	4	4	9	17	21	21	18	6	.298
4-1	No manure	(1)..	6	3	3	16	13	32	23	4	.274
e. of stable manure		1447	..	..	..	..	..	..	..	..	.367
e. of checks		1449	..	..	..	..	..	..	..	..	.337
e. of Adco Manure		1380	..	..	..	..	..	..	..	..	.313
e. of check		....	..	..	..	..	..	..	..	..	.289

(1) Yield record lost.

In this table the record of the adjacent control plot follows that of each manure plot. Comparing each in turn with its control, the results, even for the first year in an unfavorable season show some advantage from the use of manure. The yield is higher in all but one comparison. The grade index is higher for the manure treatment in each of the four comparisons.

The larger yields on the M1-1 and C3-1 plots are accounted for by location on somewhat less sandy land than the others. The yield on plot M1-1 may have been affected by shading from the station building immediately adjacent.

The season of 1927 was the reverse of 1926. There was entirely too much rain, resulting in low yield but the quality of the tobacco was much better.

During the growing season there was apparent a small difference in size, in favor of all the manured plots as compared with checks. The yield and sorting data as presented in Table 25 show that this difference was real since in every case the yield was higher on the manured plots. Also the grade index was higher in three out of the four comparisons. The exception was on the M1-1 plot which is on somewhat heavier land and since the percentage of darks was higher here than on any other plots, the reason for the lower index is apparent.

Since these four comparisons were located on different parts of the field and since these differed in physical character and apparently in natural productiveness, it is not possible to make a direct comparison of stable manure with artificial manure. By comparing each with its own control however it is apparent that both kinds of manure used as a supplement, have been about equally efficient in increasing the yield and improving the quality of the tobacco both in a dry year and a wet year.

TABLE 25. MANURE AND CHECK PLOTS. YIELD AND SORTING RECORDS. CROP OF

Plot No.	Manure Treatment	Yield per acre	Percentage of Grades								Gr. in
			L	M	LS	SS	LD	DS	Fil	BR	
M 1	Stable Manure	1375	19	16	8	6	37	3	9	2	.4
C 3	No Manure	1062	7	5	14	10	31	5	16	11	.3
C 5	No Manure	1221	11	8	18*	14	27	8	11	3	.4
M 1-1	Stable Manure	1402	7	13	12	10	40	3	11	4	.3
C 3-1	No Manure	1343	13	11	15	9	34	2	12	4	.4
C 5-1	No Manure	1291	20	15	9	10	29	3	11	3	.4
M 2	Adco Manure	1259	16	12	8	8	40	2	11	3	.4
C 14	No Manure	1161	4	7	17	9	36	4	17	6	.3
M2-1	Adco Manure	1300	22	13	5	9	37	2	11	1	.4
C 14-1	No Manure	1217	6	9	15	7	38	4	17	4	.3
Ave. of Stable Manure		1389	13	15	10	8	39	3	10	3	.4
Ave. of Checks		1232	13	10	14	11	30	4	12	5	.4
Ave. of Adco Manure		1280	19	13	7	9	39	2	11	2	.4
Ave. of Checks		1189	5	8	16	8	37	4	17	5	.3

ORGANIC MATTER IN TOBACCO SOILS

M. F. Morgan

Tobacco growers in the Connecticut valley, growing tobacco on the same fields for many years, are frequently concerned with the possibility of a depletion in the organic matter in their soils, and the consequent undesirable condition which is known to accompany such deficiency.

The average tobacco soil ranges in texture from a light loam through the intermediate grades of fine sandy loam, sandy loam, loamy sand to the coarse sand upon which much of the shade tobacco is grown. These light-textured soils are usually accepted as holding a relatively low amount of organic matter, unless the soil is of a very poorly drained type. Along the Atlantic seaboard, sandy soils are often seriously deficient in organic content. The barren sandy areas in New Jersey frequently contain less than one-half percent of organic matter in the surface soil. Sandy loam soils of the South Atlantic states rarely exceed one percent organic

matter, and the average is probably near .6 percent. Even the best agricultural practices in this region fail to build up the organic content to any considerable extent.

The average soil of the United States has been estimated by Waksman[1] to contain about 2 percent organic matter. Black clay loam soils of the Illinois prairie contain from 6 to 8 percent organic matter. The highly fertile and very heavy textured soils of the Red River valley in Manitoba frequently contain from 10 to 15 percent organic matter.

During the past year, a study has been made of the organic matter in Connecticut tobacco soils in order to ascertain the approximate level of organic content in average tobacco soils and whether or not the system of tobacco culture usually practised in this region has a tendency toward depletion in the supply of organic matter in the soil.

Results of analyses of many samples of surface soil from Connecticut fields of various types of soil and under different agricultural management show the following results:

	No. Soils included in study*	Average percent organic matter in surface soil
Upland loam and fine sandy loam soils under dairy farm rotations, chiefly cropped to corn and grass hay	41	4.27
Well drained upland loam and fine sandy loam soils in permanent pasture..........................	29	4.39
Sandy loam and fine sandy loam soils in tobacco..................	70	3.18
Very sandy tobacco soils..........	31	2.53

* Only well drained soils were included in this study.

It is evident that the amount of organic matter in all Connecticut soils is much higher than that of similar soils in states farther south along the Atlantic seaboard. An explanation of this fact is to be found in the difference in climate. With the same amount of rainfall, the organic content of the soil increases with decreasing temperature. This is in accord with well known physical laws, since the greater the temperature, the more rapid are the processes which produce destruction of organic matter in the soil.

As compared to the somewhat heavier upland soils, the tobacco soils are significantly lower in organic content. Within the tobacco district, the excessively sandy soils are more deficient in organic matter.

Investigators in the prairie region have found that there is a rapid decline in organic matter during the first few years after the

[1] Waksman, S. A. 1927. Principles of soil microbiology. 897 pp., Baltimore: Williams and Wilkins Co.

virgin soil is put under the plow. The heavy textured soils of Nebraska were found by Alway[1] to lose as much as one percent per year of their original organic content during the first thirty years of cultivation. Russell[2] and Shutt[3] both concluded that this loss becomes less with increasing periods of time. Such soils, although still very high in organic matter, have been depleted to the point where serious ill effects are to be observed.

On the other hand, the results of culture on the organic content of the soil in older agricultural regions and with somewhat different climate have frequently shown no ill effects. In the famous Broadbalk field plots at Rothamsted, wheat has been grown continuously since 1852 on Plot 8 without any organic fertilizers or manure, on commercial fertilizers alone, maintaining the yield at a consistently high level during the entire period, and with no evidences of decline. White[4] reports that applications of a mineral fertilizer containing only phosphorus and potassium has maintained the organic content of the soil during 40 years of a grain rotation. Bear and Salter[5] found that on a plot with a complete fertilizer containing only minerals, and with the removal of 117,910 lbs. of produce in 15 years, there was 3.04 percent organic matter in the soil at the end of the period, while a plot with no fertilizer, from which was taken only 40,960 lbs. of produce, showed only 2.14 percent organic matter. Bear[6] states that "soil organic matter is largely a by-product of those farming practices which result in large crop yields."

In order to throw light on the possibilities of depletion of organic matter in soils under continuous tobacco culture, two methods of study were followed.

The first of these was a comparison of the organic content of the plots of the nitrogen series at Windsor, on Merrimac sandy loam soil, sampled in the springs of 1925 and 1927. Results of the analyses are shown in Table 26.

[1] Alway, F. J. 1909. Changes in the composition of the Loess soil of Nebraska caused by cultivation. Neb. Agr. Exp. Sta. Bull. 111.

[2] Russel, J. C. 1927. Organic matter requirements of soils under various conditions. Jour. Amer. Soc. Agron. 19: 380.

[3] Schutt, F. T. 1925. The influence of grain growing on the nitrogen and organic matter content of the western prairie soils of Canada. Jour. Agr. Sci. 15: 162.

[4] White, J. W. 1927. Soil organic matter and manurial treatment. Jour. Amer. Soc. Agron. 19: 389.

[5] Bear, F. E., and Salter, R. M. 1916. The residual effects of fertilizers. W. Va. Agr. Exp. Sta. Bull. 160.

[6] Bear, F. E. 1924. Soil Management. 255 pp., New York: J. Wiley and Sons.

TABLE 26. ORGANIC MATTER IN SOIL FROM NITROGEN SERIES.

Plot No.	Nitrogen treatment	Percent organic matter 1925	1927
1	1/5 N in nitr. soda	2.53	3.24
2	½ N in nitr. soda	2.48	2.52
3	1/5 N in sulf. am.	2.60	2.38
4	½ N in sulf. am.	2.76	2.72
5	All N in organics	2.98	2.79
6	½ N in fish	3.02	3.10
7	½ N in tankage	2.28	2.72
1*	1/5 N in nitr. soda	2.86	2.93
2*	½ N in nitr. soda	3.29	2.95
3*	1/5 N in sulf. am.	3.69	3.41
4*	½ N in sulf. am.	3.38	3.55
5*	All N in organics	3.24	3.50
6*	½ N in fish	3.21	3.12
7*	½ N in tankage	3.67	3.41
1**	1/5 N in nitr. soda	3.46	3.17
2**	½ N in nitr. soda	2.91	2.91
3**	1/5 N in sulf. am.	2.81	2.95
4**	½ N in sulf. am.	3.08	3.29
5**	All N in organics	3.15	3.21
6**	½ N in fish	2.83	3.31
7**	½ N in tankage	3.71	3.45

SUMMARY AVERAGE OF ALL PLOTS TREATED ALIKE.

Plot No.	Nitrogen treatment	Percent organic matter 1925	1927	Change 1925–27
1	1/5 N in nitr. soda	2.95	3.12	+.17
2	½ N in nitr. soda	2.89	2.80	—.09
3	1/5 N in sulf. am.	3.06	2.91	—.15
4	½ N in sulf. am.	3.07	3.18	+.11
5	All N. in organics	3.12	3.16	+.04
6	½ N in fish	3.30	3.18	—.12
7	½ N in tankage	3.22	3.19	—.03

It is obvious from inspection of the data that neither in 1925, after three years of various treatments of different combinations of organic and mineral forms of nitrogen, or in 1927, after five years such treatment, has there been any appreciable effect upon the amount of organic matter in the soil. It is also seen that between 1925 and 1927 there was no consistent change in the amount of organic matter on the various plots.

One must realize that the time elapsing between sampling in this study may easily be too short for the slight changes that occur to be revealed in the analysis. Hence it was thought that a comparison between tobacco fields which have been cropped for various periods might show evidences of depletion in the older fields if any tendency toward diminishing organic content actually exists. Samples from one hundred and thirty fields were analyzed for organic matter. (In this and other similar analyses, organic matter was calculated from the amount of inorganic carbon by using the factor 1.724.)

The results are reported in Table 27 according to both character of soil and time in tobacco.

TABLE 27. ORGANIC MATTER IN TOBACCO SOILS.

	Percent organic matter Lowest	Highest	Average
Sandy loams and fine sandy loams			
21 soils 0 to 6 years in tobacco	2.10	4.89	3.16
26 soils 7 to 20 years in tobacco	2.24	5.45	3.18
27 soils over 20 years in tobacco	2.24	5.14	3.20
Very sandy soils			
16 soils 0 to 6 years in tobacco	1.98	4.17	2.82
15 soils over 6 years in tobacco	1.41	3.21	2.24
Loams and very fine sandy loams			
6 soils 0 to 6 years in tobacco	2.12	3.69	3.13
8 soils 7 to 20 years in tobacco	2.31	4.52	3.49
10 soils over 20 years in tobacco	2.22	3.78	2.80
Soils of all types			
43 soils 0 to 6 years in tobacco	1.98	4.89	3.03
44 soils 6 to 20 years in tobacco	1.41	5.45	3.03
43 soils over 20 years in tobacco	2.22	5.14	3.06

With sandy loam and fine sandy loam soils there appears to be no appreciable difference either in range or average amount of organic matter in the soil, regardless of the length of time the field has been cultivated for tobacco. These textures include the most typical tobacco soils. The amount of organic matter would seem to be sufficient to provide satisfactory conditions in soils of this character.

The very sandy soils (containing less than 20 percent silt and clay) show evidences of decrease in organic content with the longer periods of cropping. There was an insufficient number of fields in tobacco for over twenty years to justify their separation into a group.

The small number of the loams and very fine sandy loams in each time class is probably insufficient to show any definite correlation, but it was deemed advisable to separate them from the lighter textured soils.

A tabulation of all the soils shows that 43 fields in tobacco over twenty years show almost exactly the same average amount of organic matter in the soil as the same number of fields in tobacco for less than seven years, in nearly all cases after a long period of practical non-use for agricultural purposes. Many of the fields in the latter group were direct from woodland.

Since there is no significant decrease or increase in the organic content of soils under tobacco culture of the type ordinarily practised in Connecticut, except in the case of the excessively sandy soils, the decomposition of organic matter must be constantly off-

set by organic matter returning to the soil. No figures are available to show the annual decomposition of organic matter in tobacco soils, but some estimate can be made from the amount entering the soil. The fertilizer used in the tobacco district of the Connecticut Valley usually contains about 2,000 lbs. of organic material as cottonseed meal, castor pomace, fish, etc. If the tobacco stalks are returned, about 1,000 lbs. of organic matter is thus contributed. Roots and other crop residues furnish perhaps 500 lbs. of organic matter on an airdry basis. Thus the annual amount of organic matter added to the soil under continuous tobacco cropping without cover crop or manure is approximately 3,500 lbs. This is as much organic matter as would be contained in from 8 to 9 tons of ordinary manure. When cover crops or manure are used, the return of organic matter to the soil is correspondingly greater, but practise in respect to their use is so variable that it is difficult to estimate the average conditions.

The decomposition of the annual increment of organic matter entering the soil is probably quite rapid. DeTurk[1] in studies of the cumulative effect of crop residues on the Illinois fertility plots found that non-legume residues decompose rapidly when incorporated in well drained soils and that decomposition of this material was at least eighty percent.

Cottonseed meal, a highly nitrogenous, organic material, is readily decomposed in the process of liberation of its nitrogen. Its decay furnishes an important source of energy to the micro-organisms of the soil.

From the above, it appears reasonable to assume that most of the annual decomposition of organic matter is from recent crop residues, organic fertilizers and manure. The small, undecomposed residue from these sources is about equal to the amount slowly decomposing from the relatively inert organic matter which has remained in the soil in a well-humified condition for a long period.

Excessively sandy soils, under cultivation, provide optimum conditions for loss of more of the organic matter of this older type, in addition to a fairly complete decomposition of recent crop residues and manures. Thus it is more difficult to maintain the organic matter of such soils at their original level.

[1] DeTurk, E. E. 1927. Organic matter supplied in crop residues. Jour. Amer. Soc. Agron. 19: 369.

PROGRESS REPORT ON THE COVER CROP EXPERIMENTS

The problem of a winter cover crop for tobacco soils was discussed in some detail in our report for 1925.[1] Evidence was submitted to show that the timothy cover crop—which is the most commonly used one in Connecticut—is of questionable value for this purpose. Considerable evidence has accumulated since that time both in Connecticut and in other states to show that although it serves the purpose of preventing blowing and washing of the soil, timothy also has a depressing effect on the succeeding crop of tobacco. It is conceivable that there may be some fields and some conditions where this injurious influence has not operated and this explains why some growers believe their crop is benefited. Since such conditions have obviously not been present wherever controlled experiments were conducted, it seems likely that there are many fields which are injured by timothy cover crops. The evil effect is correlated with the root malady which has received the name of "*brown rootrot*" but since we know so little about this disease, we are not warranted in concluding that *all* cover crops will have the same depressing effect. The purpose of the experiments which were started at the Windsor station in the fall of 1925 was to see whether there are other crops which can serve all the useful purposes desired but without the bad after-effect of timothy.

The crops selected for test were timothy, rye, redtop, vetch, alfalfa, barley, spring wheat and oats. The first three are non-leguminous crops which live over winter, the second are examples of legumes, the last three are crops which make a large growth during the fall but die during the winter. Use of the latter three does not involve the practice of plowing under a green crop, the plants being dead and dry in the spring.

The land selected for this experiment is on Fields V and VII of the station farm and is the lightest and most sandy soil on the farm. It is believed that such soil would be most likely to show any benefits derived from cover crops. This land is not entirely uniform since it slopes in several directions from the top of a knoll and some plots are thus on somewhat more productive land. An effort was made, however, to distribute the check plots in such a way as to overcome this inequality.

The cover crops were sowed just as soon as the tobacco was harvested: August 29 in 1925, August 25 in 1926, and August 17 in 1927. All made a good growth before winter: the wheat, barley and oats were about a foot high before they were killed by freezing and made a dense mat of tops which effectually prevented blowing or washing of the land. The land was not inoculated with

[1] Conn. Agr. Station, Tobacco Bul. 6, 1926, p. 55.

bacteria for the legumes during the first year and as a result, nodules were not abundant on the roots. It was inoculated the second year and there has been an abundance of nodules since that time. The crops were plowed under on May 6 (Field VII) and May 13 (Field V) in 1926 and on April 30 in 1927.

The fertilizer mixture applied to all plots is the same as described under the manure experiments (page 64). There are 22 one-twentieth acre plots in this experiment. Each cover crop is on duplicate plots. The time of setting, harvesting, stripping and sorting is the same as described under the manure experiments.

During the very dry year of 1926, the growth on all of these plots was poor and the quality of the cured crop so unsatisfactory that it was not sorted. The yields only are presented in Table 28.

The season of 1927 on the other hand was very wet and therefore favorable to growth on this light, well-drained land. The tobacco was of good quality but of low yield. Some of the plots showed evidences of starvation before harvesting on August 4-7. Differences in growth, however, were not marked during the summer.

The tobacco from all the plots was sorted in December and was in good condition.

The yield and grading records are presented in Table 28. On account of the soil inequalities previously mentioned it will be necessary to discuss the results for each cover crop separately.

TABLE 28. COVER CROP SERIES YIELD FOR 1926–27. SORTING RECORDS FOR 192[illegible]

Plot No.	Cover crop	Yield per A		Percentage of Grades, 1927								Gra[illegible] ind[illegible] 192[illegible]
		1926	1927	L	M	LS	SS	LD	DS	F	B	
[illegible]	Timothy	1373	1203	17	10	14	6	29	7	14	3	.4[illegible]
[illegible]-1	Timothy	1666	1278	15	12	12	9	33	4	12	3	.4[illegible]
[illegible]	Barley	1430	1296	19	14	10	8	31	3	13	2	.4[illegible]
[illegible]-1	Barley	1507	1357	12	11	16	6	37	2	14	2	.4[illegible]
[illegible]	Rye	1455	1387	21	13	7	8	37	2	11	2	.4[illegible]
[illegible]-1	Rye	1717	1404	21	17	7	6	32	3	11	3	.4[illegible]
[illegible]	Oats	1678	1356	15	14	14	6	36	2	11	2	.4[illegible]
[illegible]-1	Oats	1621	1371	18	11	14	8	36	2	10	2	.4[illegible]
[illegible]0	Vetch	1642	1430	7	9	16	7	44	2	13	2	.3[illegible]
[illegible]0-1	Vetch	1479	1399	11	12	16	6	39	2	12	2	.4[illegible]
[illegible]	Check	1279	1062	7	5	14	10	31	5	16	11	.3[illegible]
[illegible]	Check	1426	1221	11	8	18	14	27	8	11	3	.41
[illegible]-1	Check	1618	1343	13	11	15	9	34	2	12	4	.4[illegible]
[illegible]-1	Check	1612	1291	20	15	9	10	29	3	11	3	.4[illegible]
[illegible]2	Alfalfa	1243	1198	13	15	9	9	39	2	11	2	.4[illegible]
[illegible]2-1	Alfalfa	1191	1238	12	13	13	8	37	2	14	1	.4[illegible]
[illegible]3	Redtop	1104	1212	10	14	8	10	38	3	15	2	.3[illegible]
[illegible]3-1	Redtop	1174	1240	16	16	9	5	37	2	13	2	.4[illegible]
[illegible]5	Wheat	1364	1261	6	9	15	11	39	3	14	3	.3[illegible]
15-1	Wheat	1137	1210	17	14	7	7	36	4	13	2	.4[illegible]
14	Check	1285	1161	4	7	17	9	36	4	17	6	.3[illegible]
14-1	Check	....	1217	6	9	15	7	38	4	17	4	.3[illegible]

ALFALFA, REDTOP, AND WHEAT

These six plots along with the two adjacent check plots (C14 and C14-1) were on Field V and cannot be compared directly with the other cover crop plots. They must be compared with their own checks.

The average yield of the check plots was 1,189 lbs. per acre as compared with 1,218 for alfalfa, 1,226 for redtop, and 1,236 for wheat. Thus all show a small increase due to the cover crop in the wet year of 1927. During the extremely dry year 1926, however, the check plots showed a slight advantage over the cover crop plots. Since, however, the entire crop was very poor on this field in 1926 we are inclined to attach more weight to the 1927 results than to those of the previous year.

From a study of the yield records, sorting records and condition notes (many of the leaves tended to be yellow and dead) it would seem that all of these plots, being on a light leachy soil, suffered somewhat from shortage of nitrogen or overripeness but that the effect was most pronounced on the plots without cover crops. This resulted particularly in a lower quality but also in a somewhat reduced yield.

TIMOTHY, RYE, OATS, BARLEY, AND VETCH

These plots were on Field VII and must be compared with the checks C3, C5, C3-1, C5-1. Since the field is not of uniform fertility it is probably best to compare in each case with the *nearest* check rather than with an average of all checks. We may analize the results for each of these cover crops:

Timothy. Since the timothy plots were immediately adjacent to the C5 check plots they should be compared with these two rather than with other check plots.

C5	Check	yielded 1426 lbs. in 1926 and 1221 in 1927.
C6	Timothy	yielded 1373 lbs. in 1926 and 1203 in 1927.
C5-1	Check	yielded 1612 lbs. in 1926 and 1291 in 1927.
C6-1	Timothy	yielded 1666 lbs. in 1926 and 1278 in 1927.

Since in three comparisons out of four, the check plots yielded more than the timothy plots we may conclude that timothy has at least not increased the yield during the first two years but has had a somewhat depressing effect. The average grade index was about the same for check and timothy plots in 1927. No quality records were made in 1926.

Barley. These plots also should be compared with the C5 plots which were nearest.

C-5	(Check)	yielded 1426 lbs. in 1926 and 1221 in 1927.
C7	(Barley)	yielded 1430 lbs. in 1926 and 1296 in 1927.
C7-1	(Barley)	yielded 1507 lbs. in 1926 and 1357 in 1927.

The yields in 1926 are contradictory but the results in 1927 are decidedly in favor of the cover crop.

Rye. The rye plots were nearest the C3-1 check and should be compared with it. Both in yield and in quality, these plots exceeded the check in 1927. In 1926 one exceeded the check while the other was not quite as good. Altogether, the results are in favor of using a rye cover crop.

Oats. In every comparison both years, the yield on the oats plots was larger than any of the check plots. The grade index in 1927 was also somewhat higher for the oats plot. These results are uniformly favorable to the use of an oats cover crop.

Vetch. The yield on these two plots was the highest of any of the field in 1927 and 3rd highest in 1926 but the color of the tobacco was dark and greenish with a high percentage of dark grades resulting in a low grade index.

For the conditions of the experiment and for 1927 only, we may say that:

1. All the cover crops with the exception of timothy increased the yield.
2. The grade index was higher on all of them with the exception of vetch which seems to have caused the tobacco to be heavier and darker.
3. Oats, barley, rye and wheat gave the best results.

TOBACCO MOSAIC[1]

G. P. Clinton and Florence A. McCormick

While Jenkins, in his History of Connecticut Agriculture, states that the Indians cultivated tobacco and that prior to 1801 more than ten tons were grown yearly in this state, we have been unable to find even a casual reference to the mosaic disease occurring here prior to 1898. It was in the Station's Report (pp. 242-60) for that year that Sturgis, then Botanist, published the first scientific discussion of the trouble in the United States, although several

[1] The year 1927 was marked by an unusually severe outbreak of the mosaic disease (calico). In view of the great interest which has thus been aroused, and to answer as far as possible the many questions which we have had, it semed wise to include this discussion in the present report.

European investigators had been writing about it for a few years previously.

In 1900 Loew (U. S. Dep. Agr. Rep. 65: 24-27) in his "Physiological Studies of Connecticut Leaf Tobacco" also had a short discussion of this trouble, while Woods (U. S. Bur. Pl. Ind. Bull. 18) in 1902 made the first general treatise on the disease in this county. Allard, after a preliminary article in 1912, published his investigations and observations (U. S. Dep. of Agr. Bull. 40), part of which were conducted in this state, in 1914. Chapman, working at the Massachusetts Station, published a preliminary article in the report of that Station in 1913 and an extended report in 1917. Thus most of the early work on the disease in this country, except that by Selby, recorded in the Ohio Station Bulletin 156 in 1904, centered in or referred to the tobacco grown in the Connecticut Valley.

The senior writer first began his studies of tobacco mosaic in the summer of 1906 when his attention was called to a serious outbreak of the trouble at Portland, Conn. The results of his several years' study were published in the Report of this Station (pp. 357-424) for 1914. About five years ago he again, with the junior author, took up the study of this disease in the hope of throwing further light upon its causal agent. No printed report of these later investigations has yet been published; the results however, have been informally discussed in scientific meetings and some of them are mentioned in this article.

EFFECT ON HOST

We shall not take much space in describing the effect of this disease on the tobacco plant since the tobacco growers of the state are all more or less acquainted with the disease. It might be well, however, to state that at first it was generally known here as "Calico". Such restricted terms as "frenching", "brindle", "mongrel", and "grey top" have been somewhat in use. Frenching has also been used to apply to "strap" leaf plants even when mosaic was not present.

The chief characteristics of mosaic are manifested in the leaves, as shown by irregular areas of lighter or yellow-green color mixed with the normal green tissues. This gives a mottled or mosaic effect. Sometimes, however, a narrow band of tissue along the veins is of a deeper green color. Other cases show the yellow-green areas almost white. This mottling is due to the destruction of the chlorophyll, or green coloring matter, in these areas and as a result the surrounding tissue grows faster, often giving a puckered effect to the leaf. In some cases the leaves are more or less distorted, extreme cases being the "strap" leaves.

In general the mosaic leaves and plants are slightly smaller than the healthy ones but if mosaic of a serious kind occurs in the very

young plants extreme dwarfing or malformation may occur. Besides this decrease in yield mosaic leaves, because of their more brittle nature, and their susceptibility to sun scorch are less valuable for cigar making and any considerable amount of mosaic in a crop is likely to reduce its value on this account. Some growers therefore refuse to harvest mosaic plants.

Calicoed plants are especially susceptible to sun scorch, when sunny, hot days suddenly follow a damp or rainy period. In such cases large irregular areas of the calicoed leaves are killed and turn a reddish-brown color known as "rust" usually called "red rust" to distinguish it from other leaf spots that occur in non-calicoed leaves. Billings in his book, "Tobacco, its Culture, Manufacture and Use", published in Hartford in 1875, recognized this trouble under the terms "Brown Rust" or "Firing", though he made no statement concerning calico which no doubt often existed as a contributory trouble.

CAUSE?

Since Sturgis' original article in 1898, much has been learned concerning mosaic of tobacco, and especially since 1914 concerning mosaic troubles in general. In fact in recent years mosaic diseases have been written about and discussed at botanical meetings perhaps more than any other one subject. They have now been recorded for a great variety of plants, and recently experimenters have begun to describe different types of mosaic on the same plant.

Yet, despite the increased knowledge along various lines, we are still ignorant of the exact causal agent of mosaic for any of these plants. Of course various theories, suggestions and beliefs have been brought forth but as yet none of these have been backed by sufficient evidence to gain general support. Some of these were made by the earliest investigators, and some by the more recent ones. The writers have tried to gain evidence to support belief in any of them, without prejudice to a particular one, but have to admit that so far they have failed.

Without going into detail the following may be named as some of the suggestions as to causal agent of mosaic that have been advanced: (1) An Ordinary Bacterium; (2) Enzymes; (3) A Toxin; (4) A Vital Fluid; (5) Environment; (6) An Ultra-microscopic Bacterium; (7) Bacteriophage; (8) Foreign Plant Protoplasm; (9) A Slime Mold; (10) A Protozoan; (11) A Chytridiaceous Fungus; (12) Mitochondria or Elaioplasts of Other Plants; (13) A Filterable Virus. Most of these names are difficult enough to make the origin obscure to the layman, even if they represented the true causal agent.

Without defining what the active principal of a "virus" is, the phrase "filterable virus" is now generally applied to the liquid from diseased tissues which after passing through a fine earthen filter

still retains the "infective principal" that will produce the disease in healthy tissues when inoculated into them under favorable conditions. Such is the case with the liquid squeezed from mosaic tobacco tissues, so investigators are agreed in calling it a "filterable virus" but as to its real nature we are still in doubt.

We do know, however, from Duggar's work (Ann. Mo. Bot. Gard. **8**: 354) that the infective principal that passes through these filters is so small that the particles are less than one thirty-third of a micron in diameter. As a micron is one twenty-five thousandth of an inch in length, these particles are much smaller than the smallest of known living things. For instance a round bacterium one micron in diameter is comparatively small for bacteria, the smallest of known living organisms, and yet it would take over thirty-seven thousand of these infective particles (if round) of the mosaic virus to make one of these round bacteria. This seems too small for them to be living organisms.

Again, so far, no one has been able to multiply these infective particles of virus outside of living plant tissues. There is no doubt that they are recreated or multiplied within mosaic plant tissues, however, since one can go on infecting healthy plants from previously infected mosaic plants through countless generations, even if one starts with a very diluted and small amount of mosaic juice on the first plant.

KNOWN FACTS OF MOSAIC

While we cannot yet properly classify the causal agent, we still have learned much about it and its relation to its hosts. For example, the senior writer was the first to prove that tobacco mosaic juice could produce mosaic diseases on other hosts when, in 1907, he infected tomato plants with it. Since then investigators have claimed to have infected a great variety of plants with it or *vice versa*. More recently, however, some are claiming that different hosts have different mosaics in many cases, while others describe several distinct virus, if not mosaic, diseases for both tobacco and potato. Our experience has been that, for a number of plants belonging to the same family as the tobacco such as tomato, pepper, ground cherry and petunia, infection from mosaic tobacco juice, through finger inoculation, is usually successful but with plants outside this nightshade family, even though in nature they sometimes developed mosaic troubles, similar inoculations with mosaic tobacco juice usually or always fail.

It has long been known that infection of tobacco plants could take place by getting mosaic juice on one's fingers and then rubbing healthy plants with them. Later Allard found that lice also could inoculate plants when traveling from mosaic to healthy ones. In ordinary seasons we believe that field infection of tobacco plants in this state takes place largely by "fingering" but the past

season, in which mosaic was so prominent, was very favorable for the development of lice on all kinds of plants and especially so on tobacco, and they apparently were an important factor in the unusual amount of mosaic tobacco.

It has been found that the mosaic virus lives over in certain perennial plants and that weeds of this nature are a source of infection for cultivated annual crops in their vicinity through lice migration, etc. We noticed this was the case in several fields of cucurbits that showed unusual mosaic infection last year.

We have learned that the "virus" is not carried in the seed of mosaic tobacco so that this is not a source of infection, which is very important to know. Likewise experience has shown that the virus does not live, at least to any great extent, in the soil over winter, since a field badly infected with mosaic one year is just as likely to be free from it the next as an entirely new field, with other conditions for the two exactly the same. We have not proven, on the other hand, that an occasional plant in a field may not have become infected from protected mosaic tobacco refuse in the soil.

We do know, however, that old tobacco refuse that has been kept dry in warehouses, barns, etc., is a decided menace in producing the disease if used in connection with young growing plants. Dried mosaic leaves kept in the herbarium as specimens for 18 to 24 years have been used by the writers to produce mosaic in healthy plants. Likewise liquid from fresh mosaic leaves, partially preserved, has produced the disease after 18 years. Valleau and Johnson of Kentucky (Phytopath. **17**: 517) have also shown that chewers of "natural leaf" tobacco can finger and spit the disease into seed beds, but such infection is not so likely to occur in this state.

While the "virus" of the disease is so easily destroyed by the moist winter conditions or by short exposure to moist heat below the boiling point, it is still very resistant to certain chemical substances at even longer exposures, such as, various strengths of alcohol, ether, toluol, corrosive sublimate, hydrogen peroxide, etc.

It was early learned that the mosaic virus injures only the young growing leaves. This means that when a growing plant is infected the mature leaves show no indications of the injury and only the upper younger growing ones become mottled; also that any sucker or sprout growth later on also becomes mottled. This is important because in the general handling of a tobacco field throughout the season, if there is only a fair amount of mosaic present at the beginning, by the end of the season most of the plants have become infected, and this shows either in the subsequent growth of leaves, sprouts or suckers. As the latest growth is never harvested, the injury to the crop, however, is not greatly increased by its presence if the marketable leaves have escaped injury.

While the mature leaves of a tobacco plant at the time of its infection will show no indication of mosaic to the naked eye, we do know that in time the virus of the disease may run down into them and the juice from their tissues is just as effective in producing the disease as that from the evidently mottled leaves above. So the macroscopic appearance of these leaves is not a sufficient test of their ability to produce mosaic infection. However, we have a microscopic test that is reliable. It will also usually detect mosaic in infected plants before visible signs appear and in some cases of slow development of mottling a long time before. This test is the presence of "plate crystals" in the cells of the infected tissues, especially in the plant hairs where they are readily detected, as these crystals are never seen in healthy tobacco.

A normally growing tobacco plant inoculated with the mosaic virus will show indications of the disease through mottling of the young leaves in 7 to 14 days after inoculation. On the other hand if the conditions of temperature, moisture or food supply are such that the plant is at a stand still or is making very slow growth, the appearance of the disease is quite apt to be delayed proportionately. We are even of the opinion that with these unfavorable conditions for plant growth, infection does not always, or at least not so readily, take place, so that we can see here the possibility of favorable and unfavorable weather conditions influencing the amount of mosaic that develops in the tobacco fields. We reach this conclusion also partly from our work with greenhouse plants under these variable conditions.

Once a tobacco plant becomes visibly infected with mosaic it rarely if ever outgrows it. There may be rare cases where the new leaves do not show the mosaic mottling but the mosaic ones, even if the mottling fades out, will still be a source of infection. Johnson of Wisconsin (Phytopath. **11**: 452) has shown that there is an optimum (28°-30° C.) and a maximum (about 36° C.) temperature for the appearance of mosaic tissue in the tobacco leaves and that when the plant is grown above the maximum, mosaic fails to appear in the new growth, thus showing at least arrested development. However, these were controlled greenhouse experiments and just how applicable they are in explaining the effect of heat in field plants growing under constantly varying temperatures is not certain. However, we think we may assume that temperatures above 36° C. are unfavorable for the development of mosaic in field tobacco.

It takes some time after the virus is inoculated into a leaf before it becomes general throughout the plant. It moves upward in the stem toward the young growing leaves faster than it does downward into the lower mature leaves. If a single leaf is inoculated it takes some hours to move through the leaf into the stem. The length of time apparently varies according to the part and age

of the leaf inoculated and how fast the plant is growing. Under ordinarily favorable conditions, a mature leaf has remained on the plant after inoculation for four days without the virus reaching the stalk and becoming a source of general infection, while a very young inoculated leaf has produced general infection after the second day.

PREVENTIVE MEASURES

With the preceding facts in mind, based also partly on practical experience, the following precautionary measures are advocated. As there is no known cure for mosaic, all treatments are preventive rather than remedial. In the first place the seed bed is the most important factor. Let mosaic get only a fair start in a seed bed and the chances are that there will be injurious outbreaks in the field. It is often hard to detect mosaic in the seed bed, because the plants are young when pulled and do not always show it even when present. The seed bed, however, should be carefully watched and if any mosaic or suspicious plants are seen these with the surrounding plants should be pulled up without touching the other plants. As mosaic is killed by moist heat, steam sterilization of seed beds for other purposes no doubt helps to keep the trouble down. If the trouble shows in the beds with no apparent reason, it may be desirable to make new beds.

The following negative precautions should also be followed with seed beds: (1) Do not make the beds on land that was in tobacco the previous year, as some of the tobacco refuse may harbor enough of the virus to infect a plant or two which will favor spread of the trouble by handling or by lice to other plants. (2) Do not use tobacco stalks, tobacco water or tobacco refuse of any kind on the beds for any purpose, as this is liable to bring in serious trouble if the mosaic virus is present in it. (3) Do not allow the men to chew "raw" tobacco while tending the beds. In weeding, pulling, etc., do not handle the plants more than is necessary, and see that the hands are kept clean by an occasional washing with soap and water. (4) An outbreak of lice, of course, should never be allowed in the seed bed.

In the field the most critical time is the transplanting. Men in setting the plants very often get their hands deeply stained with tobacco juice and if any of this happens to be from a calicoed plant they are very likely to infect a number of the plants they set out. The preventive measure of course is to handle the plants so that the juice gets on the fingers no more than is necessary and to occasionally wash the hands. Removal of infected weeds early in the season may help some. In "worming" and "suckering", especially early in the season, care should be used not to

touch the calico plants. A survey of the field may be made soon after the plants start to grow and all mosaic plants removed while they are still young. Later removal is of doubtful value.

While it will be a great satisfaction to finally know the exact cause of mosaic tobacco, it is doubtful that when this is definitely determined we will be much better off than at present as to preventive measures for its control, and probably it will bring no positive curative treatments.

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Connecticut Agricultural Experiment Station
New Haven, Connecticut

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada*

Compiled by W. E. Britton, State Entomologist.

At the present time nearly every State in the Union has laws or regulations in regard to the inspection, certification and transportation of nursery stock. These all have one object in view, namely, the control of plant pests. But conditions are not uniform throughout the United States, and each State has established such requirements as seem to give it the best protection, with the result that there are many different regulations.

This situation assumes a serious aspect to the nurseryman who may wish to fill orders received from eighteen or twenty or more different States. In order to tabulate and bring together these varying regulations in convenient form for the use of Connecticut nurserymen, this bulletin has been prepared. It should be understood that it presents only a brief digest in each case, and if any points are not clear, the nurseryman should write to the officer in charge of inspection in that State for more information.

In addition to the various State laws and regulations, there are several Federal quarantines regulating the shipment of nursery stock. A digest of these has been included in this bulletin, together with the regulations of the District of Columbia and of the Dominion of Canada.

Federal Quarantines

The following Federal Quarantines concern the shipment of nursery stock:

White Pine Blister Rust: Quarantine No. 63 prohibits the interstate movement of all five-leaved pines from the District of Columbia, all States east of the Mississippi River, Louisiana, Arkansas, Missouri, Iowa and Minnesota, into any State lying

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west of the western boundary of this area, or from one of these States into another except as they are grouped by areas. The New England States comprise one area. Five-leaved pines may not be shipped out of New England but may be shipped from one New England State to another by complying with Regulation 5 (a) and (e); viz., each car, box or container shall be marked to show contents, names of both consignor and consignee, and must be accompanied by a certificate executed by a responsible inspection official, and based on a recent inspection of stock and premises, and showing freedom from blister rust; where any State has legally established a blister rust control area, then such stock cannot enter without a permit from that State. Black currants are prohibited from interstate movement in all of the Northeastern States. Currants and gooseberries (other than black currants) may not be shipped from any New England state except in compliance with Regulation 5 (c) and (e); each car, box or container shall be marked to show contents, names of both consignor and consignee, and must be accompanied by a Federal permit tag and by a certificate executed by a responsible inspection official, and based on a recent inspection of stock and premises and showing freedom from blister rust; stock must be shipped only when dormant and must be dipped (except roots) in a mixture of one part lime-sulphur, testing not less than 32° Baumé, to eight parts water; where any State has legally established a blister rust control area, then such stock cannot enter without a permit from that State.

Narcissus Bulbs: Quarantine No. 62 provides that all varieties of narcissus bulbs can be shipped interstate only after inspection (and treatment if found infested) and certification in the State where grown. Each car, box, or other container must bear names and addresses of both consignor and consignee, list of contents, and certificate to the effect that such bulbs were found free from bulb flies and eelworms, or that such bulbs have been treated according to regulations.

Black Stem Rust of Grains: Quarantine No. 38, as amended, prohibits the interstate movement of the common species of barberry and their horticultural varieties, except the Japanese barberry; also *Mahonia* from about three-fourths of the States.

European Corn Borer: Quarantine No. 43 (third revision, as amended) provides that the stalks of common host plants of the European corn borer (which include some herbaceous perennials) cannot be shipped interstate into or through points outside of the Eastern New England infested areas unless inspected and provided with a Federal certificate.

Gipsy Moth and Brown-Tail Moth: Quarantine No. 45, as amended, regulates the interstate shipment of all nursery stock,

forest products, stone and quarry products from the infested area in the New England States, and from the generally infested to the lightly infested areas within those States. Nursery stock must be inspected and certified by Federal inspectors.

Japanese Beetle: Quarantine No. 48, as revised, regulates the interstate shipment of all nursery stock out of the infested area which includes New Jersey and certain portions of the States of Pennsylvania, Delaware, New York and Connecticut. Such stock can be shipped only after it has been examined and certified by Federal Inspectors.

Satin Moth: Quarantine No. 53, as revised, prohibits the interstate shipment from the infested areas in Maine, Massachusetts, New Hampshire, Rhode Island, Connecticut and Washington of all species and varieties of willow and poplar trees or parts thereof capable of propagation.

For further information regarding Federal quarantines and regulations address: Plant Quarantine and Control Administration, U. S. Department of Agriculture, Washington, D. C.

DISTRICT OF COLUMBIA

Each package of nursery stock entering the District must bear a valid certificate of inspection, must be marked "plants," with name and address of both consignor and consignee. No package shall be delivered to the consignee until authorized by the inspector of the Plant Quarantine and Control Administration.

Federal quarantines prohibit the entry of all five-leaved pines and *Ribes nigrum* grown in the New England States and the States of New York and Washington.

Plant Quarantine and Control Administration, Washington, D. C.

DOMINION OF CANADA

Nursery stock and all plants for ornamental purposes, propagation or cropping, from the United States, can enter Canada only after permits (and official labels, if to be sent by mail) have been procured from the Secretary, Destructive Insect and Pest Act Advisory Board, Ottawa, Canada. Applications must specify quantity, kind, value, origin and destination of stock, name and address of consignor, and consignee, the customs port, and whether to be shipped by mail, express, or freight. The importer will furnish the permit number to the shipper, and this number must be on every container, together with certificate of inspection issued at time of packing, original to accompany way-bill with copy on containers, and signed by an authorized official of the state or country where the stock originated, and the name and address of

both consignor and consignee, name of the port, and a declaration of kind and quantity of the stock. The following are designated as ports of importation:

Halifax, N. S.	Windsor, Ont.
Saint John, N. B.	Winnipeg, Man.
Montreal, Que.	Estevan, Sask.
Niagara Falls, Ont.	Vancouver, B. C.

Ottawa, Ont. (for scientific purposes only).

Mail shipments may enter the ports named above and also Toronto, Ont.

Quarantines prohibit the entrance of all conifers from New England; all five-leaved pines; all chestnut (*Castanea dentata*) and chinquapin (*Castanea pumila*), including hybrids and horticultural varieties; all currants and gooseberries, except commercial varieties of gooseberries, red and white currants cultivated for their edible fruits only; European buckthorn and all varieties of rust barberry (*Berberis vulgaris*); all varieties of *Corylus* into British Columbia from the States of Montana, Wyoming, Colorado, New Mexico, and all other states eastward; all peach nursery stock into British Columbia from Wisconsin, Illinois, Missouri, Arkansas, Texas, and all other states eastward to the Atlantic Ocean.

L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Canada.

POSTAL REGULATIONS REGARDING NURSERY STOCK SHIPPED BY PARCEL POST

The U. S. Postal Laws and Regulations, Section 467, paragraph 2, governing the mailing of plants and plant products, reads as follows:

"Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable and flower seeds, bedding plants and other herbaceous plants, bulbs and roots, may be admitted to the mails only when accompanied with a certificate from a State or Government inspector to the effect that the nursery or premises from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and plant diseases, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

STATE REGULATIONS

FILING OF CERTIFICATES IN OTHER STATES

In order to ship nursery stock into the following States, it is necessary to file duplicate inspection certificates:

Alabama	Maryland	Oklahoma
Arkansas	Massachusetts	Pennsylvania
Connecticut	Michigan	South Carolina
Florida	Minnesota	South Dakota
Georgia	Mississippi	Tennessee
Idaho	Missouri	Texas
Illinois	Nebraska	Utah
Indiana	New Mexico	Virginia
Iowa	New York	Wisconsin
Kansas	North Carolina	Wyoming
Kentucky	North Dakota	
Louisiana	Ohio	

FILING OF BONDS

Bonds are required in the following States:

Arkansas	$1,000.00	Montana	$1,000.00	Oklahoma	$1,000.00
Georgia	1,000.00			Oregon	1,000.00
Idaho	5,000.00			Utah	500.00

Tennessee requires a bond of $5.000.00 where trees are planted by outside nurserymen under contract to prune and spray for a period of years.

PAYMENT OF FEES

The payment of fees is required for registration in certain States, as follows:

State	Registration Fee	Agent's Fee	State	Registration Fee	Agent's Fee
Alabama	$10.00	$1.00	Ohio	$5.00	$1.00
	(Dealers)—	10.00	Oklahoma	5.00	
Arkansas	5.00	1.00	Oregon	20.00	1.00
Georgia	5.00	1.00	South Dakota	1.00	1.00
Idaho	10.00	1.00	Tennessee (Dealers)		5.00
Indiana	1.00	1.00	(Agent's)		1.00
Kentucky	5.00	5.00	Texas	5.00	
Maine	5.00		Virginia	10.00	1.00
Michigan	5.00		Washington	5.00	1.00
			(Dealers)	$15.00	
Montana	25.00[1]		West Virginia	20.00	
			Wyoming	15.00	

FUMIGATION

All deciduous nursery stock subject to the attack of San José scale must be fumigated with hydrocyanic acid gas and labeled with a certificate or affidavit stating that this has been done before it will be allowed to enter the following States:

Florida[2]	Mississippi	Tennessee
Maryland	North Carolina	Utah
Michigan[2]	South Carolina	

[1] Covering all Montana agents. Agents for unlicensed nurseries must pay annual fee of $10.00 and file bond of $1,000.00. Inspection fees $10.00 per car lot, smaller lots in proportion. Unlicensed nurseries, 10 per cent. of invoice price, with minimum of 50 cents per package.

[2] Fumigate all host plants of San José scale with hydrocyanic acid gas, at the standard dosage, or thoroughly scrub in a solution of fish oil soap at a dilution of one pound of soap to three gallons of water immediately before shipment into Florida. Such stock entering Michigan must bear certificate of fumigation.

STATE TAGS

State tags are required and will be furnished at the shippers' expense, by the following States:

Alabama	Mississippi	Virginia
Arkansas	North Carolina	West Virginia
Florida	South Carolina	Wisconsin
Louisiana	Texas*	Wyoming

SPECIAL INSPECTION AND CERTIFICATION OF RASPBERRY PLANTS

In an attempt to control mosaic and allied diseases of raspberry plants, certain states require two summer inspections; one in June, and the other a month later, and after all mosaic plants discovered at the first inspection have been removed. If the plants are then free from mosaic diseases, a certificate to that effect may be granted. The following states require this special inspection and certification for shipping raspberry plants:

Michigan	New York	Vermont
Minnesota		Wisconsin

REQUIREMENTS OF VARIOUS STATES

Alabama: Nurserymen in other States wishing to ship stock into Alabama must obtain an Alabama license by filing a signed copy of inspection certificate, with fee of $10.00. Each package of nursery stock entering the State must bear an Alabama tag which is furnished at cost. Dealers must register, file list of all nurseries from which they purchase stock, pay fee of $10.00, and obtain a dealer's certificate. An agent's certificate (cost $1.00) must be obtained through the principal for each agent selling nursery stock in Alabama. Nursery stock infested with San José scale, new peach scale, woolly aphis, brown-tail moth, gipsy moth, crown gall, black knot, citrus canker, peach yellows, pear blight, apple blotch, root nematode, peach borer, grape phylloxera or nut grass, must not be sold in Alabama.

B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.

Arizona: All nursery stock and plant products entering Arizona through the U. S. mails or transported in any manner shall be prominently labeled, showing (a) name and address of consignor; (b) name and address of consignee; (c) certificate of

*Texas requires tags showing an exact copy of the Texas permit but the shipper must have them printed from the original certificate.

inspection; (d) locality where grown, and (e) contents of shipment. Common carriers shall not deliver to consignee any shipment of nursery stock or plant products until inspected by the State Entomologist or his agent and a certificate of release issued in each case to the common carrier and to the consignee. Postmasters are required to forward all parcels of nursery stock or plant products to the nearest Post Office Inspection Station, and cannot forward from these stations to point of destination any parcel of nursery stock or plant products unless accompanied by an inspected plant shipment tag.

Quarantines prohibit the entrance of: Olive nursery stock and olive root cuttings from all other States and foreign countries; peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits, or trees budded or grafted upon peach stock from Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Indiana, Michigan, Illinois, West Virginia, Tennessee, North Carolina, Arkansas, Nevada, Florida, and Ontario, Can., and any other section in which peach yellows or rosette are known to exist: peach, nectarine, almond, apricot, plum, cherry, choke-cherry, quince, pear, and apple trees or plants or parts thereof including the fresh fruits, and all barrels, boxes, baskets or other containers that have been used to hold the same from the States of Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Indiana, Louisiana, Maryland, Mississippi, North Carolina, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia on account of the Oriental fruit moth. Pecan, hickory and Japanese walnut trees, cuttings, grafts, scions and buds from all outside sources, with the exception of California, on account of the pecan leaf case-bearer.

O. C. Bartlett, State Entomologist, Box 1857, Phoenix, Ariz.

Arkansas: In order to ship nursery stock into Arkansas, it is necessary (1) to file a nursery inspection certificate, pay a fee of $1.00 and secure a permit-certificate, and (2) every shipment into the State must bear a copy of the permit-certificate with the chief inspector's facsimile signature, and tags must be purchased of the chief inspector.

Out-of-state nurserymen having agents or representatives soliciting orders, or doing other nursery business in Arkansas must (1) file a bond of $1,000.00, (2) pay $5.00 for a license to do business in the State, and (3) pay $1.00 for a license for each agent in the State.

Quarantines prohibit entrance of chestnut trees from all States east of the Mississippi River.

P. H. Millar, Chief Inspector, Little Rock, Ark.

California: All shipments of nursery stock, plants, seeds, etc., into California, must be conspicuously marked with name and address of both consignor and consignee and declaration of contents and where grown. All stock entering the State is held until inspected.

Peach, nectarine or apricot trees or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots from districts where contagious peach rosette is known to exist are refused entry and will be destroyed or returned to point of shipment at option of consignor and at his expense. The States known to be infected with this disease are as follows: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Pennsylvania, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, Tennessee, Kentucky, Mississippi, Ohio, Michigan, Indiana, Arkansas, Oklahoma, and the Province of Ontario, Canada.

Quarantine order No. 4 prohibits entry of all trees, plants, grafts, cuttings or scions of all species and varieties of the cultivated filbert or hazelnut and American wild hazel (*Corylus americana*) from all States and districts east of and including Wyoming, Colorado and New Mexico. Quarantine order No. 1 prohibits entry of citrus trees and citrus fruits. Quarantine order No. 2 prohibits all chestnut and chinquapin (*Castanea* sp. and *Castanopsis* sp.) trees from all States east of east line of Idaho, Utah and Arizona. Quarantine Order No. 12 prohibits pecan trees, hickory and walnut trees from all states east of the east line of Idaho, Utah and Arizona. Quarantine order No. 3, pertaining to the Oriental fruit moth, prohibits all species and varieties, including the flowering forms, of peach, nectarine, almond, apricot, plum, cherry, choke cherry, quince, pear and apple trees and parts thereof, including the fruits and all containers of such fruits, from the States of New York, Connecticut, Pennsylvania, New Jersey, Maryland, Delaware, Virginia, West Virginia, Indiana, North Carolina, South Carolina, Florida, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Ohio, Kentucky, and Texas, and the District of Columbia.

A. C. Fleury, Supervising Quarantine Officer, Sacramento, California.

Colorado: Each package of nursery stock entering the State must bear a certificate of inspection signed by a duly authorized inspector in the State from which it was shipped. On arrival, shipments are turned over to the County Inspector, who, in turn, if they pass inspection, releases them to the consignee.

Quarantines prohibit the entrance of the common barberry.

C. P. Gillette, State Entomologist, Fort Collins, Colo.

Connecticut: Nurseries are inspected annually and nurserymen and dealers must register: nurserymen receive registration and inspection certificates, and dealers receive permits. Out-of-state nurserymen must make application and file signed copies of their valid inspection certificates and receive permits before shipping stock into the State. All stock entering the State must be accompanied by both certificate and permit, and all stock transported within the State must be accompanied by either a certificate or by a permit, and transportation companies are subject to prosecution for accepting shipments without valid certificates or permits. Nursery stock imported from foreign countries must be held unopened until inspector arrives. Inspectors have authority to inspect any stock at destination.

Quarantine prohibits the shipment of all nursery stock and forest products, unless inspected and certified, from the gipsy moth infested area to the area uninfested.

W. E. Britton, State Entomologist, New Haven, Conn.

Delaware: Each shipment of nursery stock entering the State must be accompanied by a copy of the nursery inspection certificate, and all stock must conform to the Federal rules and regulations.

Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Delaware.

Florida: Each nurseryman shall (1) file with the Nursery Inspector, Gainesville, Florida, a copy of his certificate of inspection, personally signed by the proper official of his state, and make application for permit tags on a form supplied by the Nursery Inspector; (2) secure Florida permit tags (Price list furnished); (3) attach one, and only one, Florida permit tag to each package, box or bundle of nursery stock shipped into Florida. In club orders, one permit tag should be attached to each individual order, and one permit tag attached to the package containing the individual orders; (4) each permit tag is serially numbered. An invoice showing the name and address of consignor, name and address of consignee, kind and amount of nursery stock in the shipment and number of the permit tag attached to the shipment should be mailed the Nursery Inspector, Gainesville, Florida, on the day the shipment is made. An invoice is required for each individual order in a club order and also for the package containing the individual orders; (5) return all spoiled or mutilated permit tags to the Nursery Inspector, Gainesville, Florida, for cancellation; (6) return all unused permit tags when the same become void; (7) fumigate all host plants of San José scale with hydrocyanic acid gas, at the standard dosage, or thoroughly scrub in a solution of fish oil soap at a dilution of one pound of soap to three gallons of water, immediately before shipment into Florida.

(8) Plants showing root knot, hairy root, crown gall, or any especially injurious insect or disease will not be permitted entry into the State of Florida. (9) All citrus trees and parts thereof are prohibited entry into the State of Florida from all other states and countries.

Nursery Inspector, Gainesville, Florida.

Georgia: Each nurseryman, dealer, agent, salesman or solicitor must apply to the State Board of Entomology, giving (1) the name and location of the nursery, and (2) the approximate acreage and kinds of stock grown, and receive from the Board a license: annual fee for nurserymen and dealers is $5.00: annual fee for each agent, salesman or solicitor, $1.00. Where a sale amounts to $100.00 or over, a duplicate of the complete invoice (without price) must be filed with the State Board of Entomology, within thirty days of shipment, with the name and address of the salesman and of the purchaser, and name and quality of all nursery stock sold in the State or for delivery in the State.

All nurserymen, corporations, firms or individuals selling or offering to sell nursery stock in Georgia must file with the Board of Entomology, and maintain for three years, a bond of $1,000.00 made out to the Secretary of the Georgia State Board of Entomology.

Quarantines prohibit shipment into the State of all five-leaved pines, currants and gooseberries; all nursery stock from sections of states where Japanese camphor scale is present. Shipments of plants from areas infested by the Japanese beetle, European corn borer, gipsy moth and brown-tail moth are admitted only in strict accordance with the requirements of the Federal quarantine.

E. L. Worsham, State Entomologist, State Board of Entomology, Atlanta, Ga.

Idaho: No person, firm or corporation shall import or sell nursery stock by agents within the State without first applying to the Department of Agriculture, filing a bond for $5,000.00 and obaining an annual license by paying a fee of $10.00. All shipments into the State must show name of shipper, locality where grown, variety of nursery stock and an official certificate of fumigation from the State where the stock was grown. Imported trees are fumigated before distribution, and all nursery stock shipped into the State must be inspected upon arrival at the expense of the consignee. Each nursery firm doing business in the State must annually pay an additional $1.00 for each agent. Duplicate certificates should be filed.

State quarantines exclude the entrance of all five-leaved pines, currants gooseberries, peach, nectarine, prune, almond or other trees worked on peach stock and all pits, cuttings, buds or scions

grown in a district where peach yellows or other detrimental diseases exist.

Permits for entry must be secured from the Bureau of Plant Industry and accompany the shipment before any currants or gooseberries can be shipped into the state. The eight northern counties are designated as a blister rust control area from which currants, gooseberries and five-leaved pines are excluded.

M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.

Illinois: Before shipping nursery stock into Illinois, a signed duplicate copy of the certificate of inspection must be filed with the Division of Plant Industry. Nurseries and dealers employing salesmen must file in the office of the Chief Inspector a complete list of such salesmen representing them within the State, and apply, after July 1, for an agent's permit for each salesman employed in the State. All nursery stock entering the State must bear a valid certificate of inspection, names and addresses of consignor and consignee and nature of stock. If stock arrives without such certificate it must be reported immediately to the Division of Plant Industry, and held until released.

A quarantine order excludes from the New England states all species of Castanea. Stock shipped into Illinois in violation of any State or Federal quarantine is destroyed or returned to the consignor or otherwise disposed of at the discretion of the Department.

P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Illinois.

Indiana: Nursery stock entering or shipped within the State must bear an official inspection certificate, and give the names of both the consignor and the consignee. All out-of-state nurseries must file with the State Entomologist a copy of their valid inspection certificate, pay $1.00, and obtain a license good for one year from date of issue, before shipping stock into the State. Each dealer and agent selling or soliciting sales of nursery stock in Indiana must pay $1.00, and obtain a license from the State Entomologist.

Frank N. Wallace, State Entomologist, Department of Conservation, Indianapolis, Ind.

Iowa: Copy of inspection certificate must be filed with and approved by the State Entomologist, and must accompany each shipment into the State.

Quarantine against European corn borer prohibits all the usual host plants entering the State from the infested areas in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio and Michigan.

Carl J. Drake, State Entomologist, Ames, Iowa.

Kansas: Nurseries are inspected annually and all certificates and dealers' permits lapse on June 1, following date of issue. Nursery stock may be shipped into the State when accompanied by a recognized certificate of inspection. Duplicate certificates must be filed.

James N. Farley, Secretary, Entomological Commission, Topeka, Kans.

Kentucky: Kentucky nurseries are inspected annually and certificates are issued when stock is found free from dangerous pests. All nurserymen, resident or non-resident, must file, annually, credentials at this office and if in good standing receive a permit on payment of a fee of five dollars.

Agents and dealers must file credentials annually, including names of "nurseries, nurserymen, or persons represented," and on payment of a fee of five dollars are issued a permit. Agents while soliciting orders must carry their permits, to show to prospective buyers, county officials, or agents of the State Entomologist, on demand. Quarantines are provided for.

H. Garman, State Entomologist, Lexington, Ky.

Louisiana: Before shipping nursery stock into Louisiana, application must be made to the Entomologist for permit by filing copy of valid certificate, and order for certificate tags accompanied by money to pay for them (price on application). The Louisiana tag and the inspection certificate of the state where the stock was grown must both accompany each shipment. The invoice stub of each permit tag must be filed with the Entomologist once a week, showing the number and varieties of plants shipped.

W. E. Anderson, State Entomologist, Department of Agriculture, Baton Rouge, La.

Maine: All individuals or firms selling or soliciting sales of nursery stock which they have not grown shall annually obtain a license from the State Horticulturist by paying a fee of $5.00. All stock entering the State shall bear on each box or package a valid inspection certificate: such stock may be inspected at destination and if found infested with dangerous pests may be destroyed or returned to the consignor.

Quarantine prohibits entrance of currant or gooseberry plants. Five-leaved pines cannot enter without a permit from the Forest Commissioner.

George A. Yeaton, State Horticulturist, Augusta, Me.

Maryland: Nurseries are inspected twice each year. Nursery stock coming from blocks that show evidence of San José scale must be hand inspected to eliminate visibly infested stock, and the balance fumigated before shipment. Shipments entering the State must bear certificates of inspection besides names of

consignor and consignee. Duplicate certificate should be filed with the State Entomologist.

Quarantines prohibit the shipment of five-leaved pines, currants and gooseberries from New York, the New England States, Pennsylvania, New Jersey, Michigan, Wisconsin, Minnesota and Washington; also into the non-infested counties of Maryland, of any nursery stock of peach or sweet cherry from areas infested with the Oriental peach moth.

Ernest N. Cory, State Entomologist, College Park, Md.

Massachusetts: All growers and agents who sell nursery stock for delivery within the State must have a grower's certificate or an agent's license, and a copy of such certificate or license must accompany each car, box or package of stock shipped or delivered. Agents must apply to Director, Division of Plant Pest Control, Boston, Mass., and file list of nursery firms from which they purchase stock before receiving agent's license. Authority is granted to inspect at destination all stock entering the State, and if found infested may be destroyed, treated, or returned to the consignor at his expense.

Quarantines prohibit *Ribes* from entering the State except under permit.

R. H. Allen, Director, Division of Plant Pest Control, Boston, Mass.

Michigan: All nurseries are inspected annually. Each out-of-state nurseryman who sells in Michigan through personal representatives must file a certified copy of his original certificate, and pay a fee of $5.00 and obtain a license permitting him to ship stock into the State. Each shipment must bear an exact copy of the inspection certificate issued in the state from which the stock was shipped, names and addresses of both consignor and consignee, and a statement showing the general nature of the contents. Out-of-state nurserymen wishing to sell nursery stock in Michigan through catalogue must file copies of their original certificates of inspection. All nursery stock entering the State (except conifers and herbaceous plants) subject to the attack of San José scale must be fumigated with hydrocyanic acid gas in the usual manner and must bear a certificate from the shipper that such fumigation has been given.

The law and quarantine regulations prohibit the entrance of all barberries subject to the attack of black stem rust of grains; all chestnut trees; all trees and plants from areas infested by the Japanese beetle and European corn borer except in compliance with Federal regulations; all raspberries unless bearing certificates that the plants have been properly inspected for virus diseases, as under Rules and Regulations No. 273. Currants and gooseberries

shipped into Michigan must be accompanied by Control Area Permit issued by the Commissioner of Agriculture.

E. C. Mandenburg, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.

Minnesota: All shipments must be accompanied by a valid certificate of inspection on the outside of each package. A copy of this certificate must be filed with the State inspector before nursery stock is shipped into the State. No filing fee is required. A license is not required for agents or salesmen.

The term nursery stock includes all wild and cultivated trees, shrubs, vines, small fruit plants, perennial roots, rhizomes, herbaceous perennials, cuttings, buds, grafts and scions for or capable of propagation. A certificate of inspection is not required for greenhouse or house-grown plants, bedding plants, herbaceous annuals, vegetable plants, bulbs, corms and tubers.

Minnesota quarantine No. 6 requires that all raspberry plants shipped into Minnesota must have been inspected under regulations substantially similar to Minnesota regulations for the certification of such plants. Each package must be accompanied by a valid certificate showing that the plants were inspected and conform to such regulations. A special affidavit signed by the shipper may be accepted in lieu of such certificate on each package.

All nursery stock for shipment into Minnesota must comply with the requirements of Federal quarantines.

A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi: Each package of nursery stock shipped into Mississippi must have attached to it a Mississippi permit tag and a certificate issued by the state inspection official of the state where grown. Also, there must be a statement or tag on each shipment showing the name and address of both consignee and consignor, the general nature and quantity of the contents, and the name of the locality where grown. The permit tags may be obtained at actual cost from the Nursery Inspector, A. and M. College, Mississippi, after a satisfactory certificate of inspection issued by the duly authorized state official has been filed with him. The proprietor or manager of the nursery or greenhouse must sign and file with the Plant Board an agreement with reference to complying with the Mississippi laws in shipping nursery stock into Mississippi.

shipped into Michigan must be accompanied by Control Area Permit issued by the Commissioner of Agriculture.

E. C. Mandenburg. In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.

Minnesota: All shipments must be accompanied by a valid certificate of inspection on the outside of each package. A copy of this certificate must be filed with the State inspector before nursery stock is shipped into the State. No filing fee is required. A license is not required for agents or salesmen.

The term nursery stock includes all wild and cultivated trees, shrubs, vines, small fruit plants, perennial roots, rhizomes, herbaceous perennials, cuttings, buds, grafts and scions for or capable of propagation. A certificate of inspection is not required for greenhouse or house-grown plants, bedding plants, herbaceous annuals, vegetable plants, bulbs, corms and tubers.

Minnesota quarantine No. 6 requires that all raspberry plants shipped into Minnesota must have been inspected under regulations substantially similar to Minnesota regulations for the certification of such plants. Each package must be accompanied by a valid certificate showing that the plants were inspected and conform to such regulations. A special affidavit signed by the shipper may be accepted in lieu of such certificate on each package.

All nursery stock for shipment into Minnesota must comply with the requirements of Federal quarantines.

A. G. Ruggles, State Entomologist, University Farm, St. Paul, Minn.

Mississippi: Each package of nursery stock shipped into Mississippi must have attached to it a Mississippi permit tag and a certificate issued by the state inspection official of the state where grown. Also, there must be a statement or tag on each shipment showing the name and address of both consignee and consignor, the general nature and quantity of the contents, and the name of the locality where grown. The permit tags may be obtained at actual cost from the Nursery Inspector, A. and M. College, Mississippi, after a satisfactory certificate of inspection issued by the duly authorized state official has been filed with him. The proprietor or manager of the nursery or greenhouse must sign and file with the Plant Board an agreement with reference to complying with the Mississippi laws in shipping nursery stock into Mississippi.

Each agent or salesman representing nursery firms is required to register with and obtain an agent's certificate from the Nursery Inspector before selling, delivering, or taking orders for nursery stock in Mississippi.

All plants capable of defoliation must be defoliated.

Each individual order in a club order destined for a Mississippi point must have a Mississippi permit tag attached. Upon using a Mississippi permit tag, the nurseryman must immediately mail the Nursery Inspector, A. & M. College, Mississippi, an invoice stub showing the name and address of the consignee and an itemized list of plants in the shipment. Mutilated, spoiled and unused permit tags must be returned to the Mississippi Nursery Inspector. All permit tags remaining on hand at the close of the season must be returned.

Plants infected with root knot (caused by nematodes), crown gall, or showing any insect pest or disease or markings thereof, must not be shipped into Mississippi.

A circular explaining the Mississippi requirements in more detail will be sent upon request.

George F. Arnold, Nursery Inspector, A. and M. College, Mississippi.

Missouri: Outside nurseries must file necessary papers including certificate and apply for a permit certificate which will be issued without fee. All agents or salesmen must apply for agent's certificate. Each package of nursery stock entering the State must bear the names of both consignor and consignee, statement of contents, and a certificate showing that the stock therein contained has been inspected where grown by a duly authorized inspector and found to be apparently free from dangerously injurious insect pests and plant diseases. Transportation companies are not permitted to deliver nursery stock unless so labeled.

Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.

Montana: All nursery stock entering the State must be unpacked and inspected at one of the following designated quarantine stations: Billings, Butte, Miles City, Missoula, Sanders or Fairview. All shipments entering the State are subject to inspection with fees as follows: licensed nurseries, car lots $10.00, smaller lots proportionate; unlicensed nurseries, ten per cent of invoice price of shipment with minimum of 50 cents per package. Notice of shipment including list of stock and names of transportation company, consignor and consignee must be sent to the Chief, Division of Horticulture, Missoula, Montana, five days prior to shipment.

Nurserymen are required to pay an annual fee of $25.00 and file a bond of $1,000.00 in favor of the State of Montana; this includes licenses for all Montana agents. Agents for unlicensed nurseries must pay an annual fee of $10.00 and file bonds of $1,000.00.

Quarantines prohibit the entrance of the common barberry and black currant from all states, and of all five-leaved pines, currant

and gooseberry plants from the states east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana and all of the State of Washington.

Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.

Nebraska: Non-resident nurserymen, dealers, or other persons wishing to ship nursery stock into Nebraska must file a duplicate certified copy of their original certificate with the State Department of Agriculture. If this certificate is approved by the Department of Agriculture, they will be issued a permit allowing them to ship nursery stock into this state during the period that such original certificate issued by the state in which they reside or are doing business is in force. No fee is charged for the non-resident dealer's or nurseryman's permit. Each shipment of nursery stock coming into the state must be plainly and legibly marked in a conspicuous place with a statement showing: (a) the name and address of the consignor; (b) the name and address of the consignee; (c) the general nature of the contents; (d) the name of locality where grown; and (e) a certificate of inspection from the proper official of the state, territory, district, or country from which it was shipped. All agents selling nursery stock or soliciting orders for nursery stock for any nurseryman or dealer located either within or without the state of Nebraska shall be required to secure and carry an agent's permit. The fee for this permit is $1.00.

Any prohibited insect pest or plant disease, plant product or other substance or thing, brought into the state in violation of any regulation of the State Department of Agriculture or any Federal Quarantine, shall at the expense of the owner be either destroyed, returned to the consignor, or otherwise disposed of as the Department of Agriculture may direct.

H. J. McLaughlin, Secretary; L. M. Gates, Inspector, State Department of Agriculture, Lincoln, Nebraska.

Nevada: All nursery stock entering the State must bear on each car, bale, or package a copy of a valid official inspection certificate, and names of consignor and consignee. Transportation companies shall not deliver nursery stock lacking such certificate.

Quarantine prohibits entry of any pine trees, currant or gooseberry plants or cuttings from east of the Mississippi River or from foreign countries, and of fruit trees, and fresh fruits and their boxes or containers, from any States infested by the Oriental fruit moth.

George G. Schweis, Entomologist, State Quarantine Office, University of Nevada, Reno, Nev.

New Hampshire: All nursery stock entering this State must bear on each container a copy of a valid inspection certificate.

Quarantines prohibit the entrance of currants or gooseberries into any part of the state, except an area in the northernmost part of the state, beginning with the towns of Stratford, Odell, Millsfield and Errol; require permit for importation of any five-leaved pines, and special certificate from state of origin, in accordance with Federal regulations; prohibit entry of plants susceptible to attack by the European corn borer, the gipsy moth, and the browntail moth from infested regions into uninfested territory, except with proper certificate; prohibit entry of plants susceptible to attack of the satin moth from infested regions into uninfested territory.

W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, New Hampshire.

New York: Nursery stock cannot enter the State or be moved within the State unless a valid certificate is attached issued by the New York State Department of Agriculture and Markets, or by the State in which the shipment originated. Transportation companies and all persons bringing nursery stock into the State must send notice to the Department of Agriculture and Markets. Blanks will be furnished for such notices. An exact copy of the certificate must be attached to each package sent by mail. Stock received from abroad or from other States unaccompanied by a valid certificate of inspection must not be unpacked or distributed until after inspection and release by Department of Agriculture and Markets.

Quarantines prohibit the entrance of five-leaved pine trees from New England, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin and Minnesota; also of Christmas trees and woody greens from New England except from those areas lightly or not infested by gipsy moth (Federal certificates must accompany shipments from the lightly infested area); of raspberry plants unless apparently free from mosaic diseases and are so certified after two inspections and the removal of all diseased plants, as is practiced in New York State. Currants and gooseberries cannot be grown in certain pine-growing areas of the State and permits must be obtained to ship them into the State. Name and address of consignee must be given in application.

B. D. Van Buren, Director, Bureau of Plant Industry, Department of Agriculture and Markets, Albany, N. Y.

New Jersey: Each car or parcel of nursery stock entering the State must bear a copy of a valid inspection certificate, with a statement from the shipper that the contents are a part of the stock inspected and whether or not it has been fumigated with hydrocyanic gas. Transportation companies shall refuse for transportation within the State all nursery stock not accompanied by a certificate of inspection. All such stock entering the State

may be inspected wherever found, and if infested with dangerous pests, will be destroyed.

Common carriers and New Jersey nurserymen who bring nursery stock into the State shall send notice of each shipment with full data prior to, or within twenty-four hours after, its arrival.

Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.

New Mexico: Before shipping nursery stock into New Mexico, a duplicate copy of a valid certificate of inspection must be filed and a permit obtained.

Quarantine prohibits the entrance of *Ribes* and *Grossularia.*

H. L. Kent, President, Agricultural College, State College, N. Mex.

North Carolina: Nursery stock can enter the State only when shipments bear North Carolina official permit tags, which will be supplied at cost on request, and the filing of a duplicate inspection certificate accompanied by an affidavit that all fruit stock will be fumigated.

Quarantines prohibit the entrance of five-leaved pines and *Ribes* except in accordance with Federal regulations.

R. W. Leiby, Entomologist, State Department of Agriculture, Raleigh, N. C.

North Dakota: Nursery stock entering the State must bear inspection certificates. Every person employing agents or salesmen or who solicits for the sale of nursery stock, must file a duplicate inspection certificate.

Director, North Dakota Experiment Station, Agricultural College, N. D.

Ohio: Out-of-state nurserymen must file copies of their inspection certificates and obtain an Ohio certificate permitting them to solicit orders for nursery stock. Each dealer within or without the State shall obtain annually a dealer's certificate, by furnishing an affidavit that he will buy and sell only inspected stock and will maintain with the Secretary of Agriculture a list of all sources from which he obtains nursery stock. Each affidavit shall be accompanied by a fee of $5.00. All agents soliciting orders for nursery stock shall file annually a statement that he will sell only inspected stock, and pay a fee of $1.00. He shall carry an agent's certificate and a copy of the certificate held by his principal.

Each shipment entering the State shall be accompanied by a tag or poster giving an exact copy of the valid certificate. Altered certificates are prohibited.

Quarantines prohibit the entrance or shipment within the State of the common barberry and its horticultural varieties, and the common host plants of the European corn borer.

Richard Faxon, Chief, Division of Plant Industry, Department of Agriculture, Columbus, Ohio.

Oklahoma: Nursery stock entering the State must bear on each package of each shipment an inspection certificate. Nurserymen must each file a duplicate copy of their valid inspection certificate, and furnish a surety bond of $1,000.00 in favor of the State Board of Agriculture. A permit will be issued on payment of the fee of $5.00, and a copy of this permit must be attached to all shipments entering the State of Oklahoma.

All dealers within or outside the State must attach to each package of each shipment a copy of the dealer's certificate issued to them by the Board of Agriculture.

Thomas B. Gordon, State Nursery Inspector, Oklahoma City, Okla.

Oregon: Shipments of nursery stock entering the State must be plainly marked, with names and addresses of both consignor and consignee, name of state, territory, or country where grown, and nature of contents. All shipments are inspected, and the unlicensed sale or distribution of nursery stock is unlawful. Nurserymen must apply for licenses, pay a fee of $20.00, and furnish a bond of $1,000.00, that in case the license is issued all stock delivered shall be free from pests and true to name. The fee for an agent, solicitor, or salesman is $1.00.

Quarantines prohibit the entrance of grape vines; all species and varieties of chestnut and chinquapin; all hazel and filbert trees, plants, cuttings, and scions from the Eastern states; all species and varieties, including the flowering forms of peach, almond, nectarine, apricot, plum, cherry, quince, pear, and apple trees or parts thereof from the Eastern states.

Charles A. Cole, Secretary, State Board of Horticulture, Portland, Oregon.

Pennsylvania: Each nurseryman from outside of the State must file with the Director of the Bureau of Plant Industry a duplicate copy of his valid inspection certificate, signed in person by the State Inspection Official in charge, and supply a statement giving the exact acreage of nursery stock he is growing as well as the acreage being grown for him under contract. Upon compliance with these regulations a certificate is issued which must be received before stock is shipped into the state. Dealers are granted certificates on application and receipt of a statement from each that he will buy stock only from nurseries holding valid certificates of inspection. Agents soliciting for the sale of nursery stock in the state must obtain and carry agents' duplicate certificates. All shipments of nursery stock entering the state will be rejected unless accompanied by certificates of inspection.

Interstate quarantines prohibit the entrance of *Ribes*, five-leaved pines, all barberry plants except Japanese barberry, and shipments of Christmas trees or woody greenery from the gipsy moth districts of New England and Canada.

R. H. Bell, Director, Bureau of Plant Industry, Harrisburg, Pa.

Rhode Island: All stock entering the State must bear a valid official certificate of inspection, but is subject to further inspection and may be destroyed or returned to the consignor if found infested. Agents must obtain agents' licenses, on stating where they expect to purchase their stock.

Five-leaved pines and *Ribes* can be shipped into the State or planted in certain parts of the State only on permission. Planting of black currant and flowering currant is prohibited.

A. E. Stene, State Entomologist, State House, Providence, R. I.

South Carolina: Each package of nursery stock entering the State must bear a permit tag of the South Carolina State Crop Pest Commission, which may be obtained at cost by filing a duplicate certificate of inspection and fumigation.

Quarantines prohibit the entrance of five-leaved pines, currants, gooseberries and all host plants of the European corn borer except when shipped in conformity with Federal regulations. Citrus stock is allowed to enter only by special permit. Fumigation of host plants of San José scale is required.

South Carolina State Crop Pest Commission, Clemson College, S. C.

South Dakota: Out-of-State dealers may obtain certificates permitting them to solicit and fill orders in the State, by filing with the Secretary of Agriculture a certified copy of their official inspection certificates and by paying a fee of $1.00 each. All agents shall likewise obtain and carry agents' certificates bearing copies of the certificates held by their principals, and paying fees of $1.00 each.

Quarantines prohibit the entrance of all five-leaved pines and *Ribes;* of all poplars and willows from areas infested by the satin moth; all host plants of the European corn borer.

Louis N. Crill, Secretary of Agriculture, Pierre, S. D.; R. W. Vance, Nursery Inspector, Brookings, S. D.

Tennessee: Out-of-state nurseries must file duplicate inspection certificates and the following agreement regarding fumigation:

> "We, the undersigned, agree to fumigate with hydrocyanic acid gas, according to the required strength, all nursery stock subject to attack from San José scale and other dangerous insect pests. We also agree to attach a fumigation tag to each and every shipment going into the State of Tennessee."

Every shipment must bear a valid inspection certificate and a fumigation tag, and failure to comply with these requirements subjects the stock to confiscation.

Nursery agents and dealers must file sworn statements on official Tennessee blanks which will be supplied. Each agent operating in Tennessee must pay a license fee of $1.00, and each dealer or jobber must pay $5.00.

Nurserymen selling trees under contract to prune and spray the same for a period of years are required to take out a bond of $5,000.00 before selling trees under such special contract.

State quarantines prohibit the entrance of all varieties of barberry except *Berberis thunbergii;* all varieties of chestnut and chinquapin from all States where chestnut blight occurs. Other restrictions apply to Japanese beetle, European corn borer, gipsy moth, sweet potato weevil and pink bollworm of cotton. Peach and pecan seedlings are allowed entrance only by special permit for experimental purposes.

G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.

Texas: Nurserymen, florists, and others who desire to make shipments of nursery stock into Texas, should apply to the State Department of Agriculture, Austin, Texas, for a Texas permit. The application should be accompanied by a certified copy of certificate of inspection from the State Inspector of the state in which the stock to be shipped is located, together with a registration fee of $5.00. The fee must be remitted in the form of postoffice money order, cashier's check, or bank draft. It will also be necessary for the applicant to sign an agreement to comply with the Texas regulations. The proper form for this signature will be sent upon request. Permits are issued annually and expire August 31st of each year. This general certificate does not cover citrus nursery stock. Any individual desiring to make shipments of citrus nursery stock into the state should communicate directly with the Commissioner of Agriculture.

All shipments of nursery or floral stock originating outside of the state must bear shipping tags showing the exact copy of certificate of inspection from the state inspector of the state in which the shipments originate; and in addition thereto must have tags showing the exact copy of the Texas permit. The Department of Agriculture does not furnish the Texas permit tags, and the shipper should have them printed from the original certificate. Common carriers are prohibited by law from releasing shipments of nursery stock which are untagged, in accordance with these regulations.

Nurserymen and florists of all states who ship nursery and floral stock into Texas are requested to file with the Department of Agriculture a copy of invoice or memorandum of each and

every shipment of stock made into the state, giving the date, consignor, consignee, and a list of stock shipped. The price need not be given.

Those intending to ship orange and citrus seed of all kinds into Texas must furnish the Texas Department with a certified statement from their State Plant Board that the seed was gathered from citrus-canker-free territory, and also an affidavit that the seeds to be shipped were treated in a corrosive sublimate solution of a strength of 1-1000.

Agents or dealers operating in Texas for nurserymen and florists outside of the state must procure proper credentials from the nurserymen they represent. The form for this credential approved by the Commissioner of Agriculture is furnished free of charge. Each agent or dealer must be prepared to present such credential at all times.

Dealers are classed as nurserymen and are required to take out permits. Greenhouses and greenhouse plants are included for inspection by the Texas laws.

J. M. Del Curto, Chief Nursery Inspector, Department of Agriculture, Austin, Texas.

Utah: Out-of-state nurserymen must file with the Board of Agriculture a valid official inspection certificate, and names of their agents in Utah, and obtain (without fee) an annual license; file a bond for $500.00 that they will comply with the law and to cover cost of inspection, fumigation, or destruction of stock shipped into the State or sold by their agents. Agents and salesmen representing out-of-state firms must carry proper credentials.

All nursery stock entering the State must bear a valid official inspection certificate and an official certificate that the shipment has been given a cyanide fumigation for 45 minutes at the rate of one ounce to each 100 cubic feet of enclosed space. Also a notice of each shipment giving duplicate invoice, list of contents, date, and names of both consignor and consignee must be mailed to the State Agricultural Inspector. Any out-of-state shipment not bearing the proper license and certificate tags will be placed in quarantine and inspected and disinfected at the owner's expense.

F. E. Stephens, State Agricultural Inspector, State Board of Agriculture, Salt Lake City, Utah.

Vermont: All nursery stock entering the State must bear valid official inspection certificates and the names and post office addresses of both consignor and consignee.

Quarantines restrict the free movement of raspberry plants on account of mosaic, leaf roll and rosette, hosts of the European corn borer, and all uninspected and non-nursery grown trees and forest products on account of the gipsy and brown-tail moths.

M. B. Cummings, State Nursery Inspector, Burlington, Vt.

Virginia: All nurseries must file valid inspection certificates with the State Entomologist for the current season and pay a registration fee of $10.00 for principals; duplicates for agents' use $1.00 each. Checks should be made payable to the *Treasurer of Virginia.* Official state tags must accompany each package of stock entering the state. Registration certificates expire annually on August 31st.

Christmas greens originating in the States of Maine, New Hampshire, Massachusetts, Vermont, Connecticut and Rhode Island are prohibited on account of the gipsy and brown tail moths unless each shipment is accompanied by a certificate showing that it has been inspected officially and found to be free from such pests.

G. T. French, State Entomologist, Department of Agriculture, Room 1112 State Office Building, Richmond, Virginia.

Washington: No person, firm or corporation shall sell, solicit sales, or distribute nursery stock except berry plants, without first obtaining a license to do so from the Director of Agriculture. The license fee is $5.00 for nurserymen who grow all the stock they sell, $15.00 for other nurserymen, dealers, brokers and landscape architects, and $1.00 for agents, salesmen and solicitors. All licenses expire July 1. All nursery stock entering the State shall have contents, names and addresses of consignor and consignee, and name of state, territory, or country where stock was grown, plainly marked on each car, box, bale or package. The State is divided into eleven horticultural districts with an inspector-at-large in charge of each district. Notice must be sent to one of these inspectors of any shipments arriving without the proper license certificate or labels, and the said inspectors are authorized to inspect such shipments and charge such fees as may be fixed by the Director of Agriculture.

Quarantines prohibit the entrance of five-leaved pines, currants and gooseberries, chestnut and chinquapin, hazel and filbert, and carriers of the European corn borer, peach yellows, and Oriental peach moth.

J. I. Griner, Supervisor of Horticulture, Olympia, Washington.

West Virginia: All nursery stock entering the State must bear a valid certificate of inspection and a West Virginia permit tag. No nursery stock shall be sold, offered for sale or delivered, without first obtaining from the Commissioner of Agriculture a certificate of registration; annual fee $20.00.

W. E. Rumsey, State Entomologist, Morgantown, W. Va.

Wisconsin: Each out-of-state nurseryman must file a valid certificate of inspection and obtain a State license before shipping stock into the State. Each car, or package, must bear certificate tags. Each agent selling nursery stock in the State must carry

an agent's duplicate certificate bearing the same number and date as that of his principal. No fees are charged except for resident nurserymen.

Quarantines prohibit entrance of all five-leaved pines and all barberry bushes (except Japanese barberry) and host plants of European corn borer from infested areas; nursery stock from gipsy moth infested areas except under Federal Certificate; cranberry plants; raspberry plants unless certified to a special inspection for virus diseases.

E. L. Chambers, State Entomologist, Madison, Wis.

Wyoming: Each out-of-state nurseryman must file a valid certificate of inspection and deposit a fee of $15.00 and receive a license good until the following July 1st. Authorized shipping tags are furnished at cost, and carriers are forbidden to deliver unless each shipment bears such a tag.

Quarantines prohibit entrance of all five-leaved pines, currants and gooseberries.

C. L. Corkins, State Entomologist, Laramie, Wyoming.

OFFICERS IN CHARGE OF INSPECTION AND QUARANTINE SERVICE

Alabama.........B. P. Livingston, Chief, Division of Plant Industry, Montgomery, Ala.
Arizona..........O. C. Bartlett, State Entomologist, Phoenix, Ariz.
Arkansas.........P. H. Millar, Chief Inspector, Little Rock, Ark.
California........A. C. Fleury, Supervising Quarantine Officer, Sacramento, Cal.
Colorado.........C. P. Gillette, State Entomologist, Fort Collins, Colo.
Connecticut W. E. Britton, State Entomologist, New Haven, Conn.
Delaware.........Ralph C. Wilson, Secretary, State Board of Agriculture, Dover, Del.
Florida...........Nursery Inspector, State Plant Board, Gainesville, Fla.
Georgia..........E. L. Worsham, State Entomologist, Atlanta, Ga.
Idaho............M. L. Dean, Director, Bureau of Plant Industry, Boise, Idaho.
Illinois...........P. A. Glenn, Chief Inspector, Division of Plant Industry, Urbana, Ill.
Indiana..........Frank N. Wallace, State Entomologist, Indianapolis, Ind.
Iowa.............Carl J. Drake, State Entomologist, Ames, Iowa.
Kansas...........James N. Farley, Secretary, Entomological Commission, Topeka, Kans.
Kentucky........H. Garman, State Entomologist, Lexington, Ky.
Louisiana.........W. E. Anderson, State Entomologist, Baton Rouge, La.
Maine...........Geo. A. Yeaton, State Horticulturist, Augusta, Me.
Maryland........E. N. Cory, State Entomologist, College Park, Md.
Massachusetts....R. H. Allen, State Nursery Inspector, State House, Boston, Mass.
Michigan.........E. C. Mandenberg, In Charge of Orchard and Nursery Inspection, Department of Agriculture, Lansing, Mich.
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Mississippi.......Geo. F. Arnold, Nursery Inspector, Agricultural College, Miss.
Missouri.........Leonard Haseman, State Entomologist and Chief Inspector, State Plant Board, Columbia, Mo.
Montana.........Edward Dickey, Chief, Division of Horticulture, Missoula, Mont.
Nebraska.........H. J. McLaughlin, Secretary; L. M. Gates, Inspector, State Department of Agriculture, Lincoln, Nebr.
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New Hampshire...W. C. O'Kane, Deputy Commissioner of Agriculture, Durham, N. H.
New Jersey.......Harry B. Weiss, Chief, Bureau of Statistics and Inspection, State Department of Agriculture, Trenton, N. J.
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South Carolina....South Carolina State Crop Pest Commission, Clemson College, S. C.
South Dakota.....Louis N. Crill, Secretary of Agriculture, Pierre, S. D.
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Washington.......J. I. Griner, Supervisor of Horticulture, Olympia, Wash.
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Wisconsin........E. L. Chambers, State Entomologist, Madison, Wis.
Wyoming.........C. L. Corkins, State Entomologist, Laramie, Wyo.

Federal Quarantines
and District of
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Dominion of
Canada..........L. S. McLaine, Secretary, Destructive Insect and Pest Act Advisory Board, Department of Agriculture, Ottawa, Can.